The obstacles to using technologies in primary schools to help students with mathematics difficulties in the Kingdom of Saudi Arabia

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By

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Abstract

Despite the potential positive effects of using technology with students who have difficulties in mathematics in the Kingdom of Saudi Arabia and the great efforts made by the Saudi Government to improve the education system of the nation, which has included a continuous rise in the educational budget, there still remain some obstacles for some teachers when using technology, and while some of these teachers overcome these barriers, others do not succeed in this the challenge. This study investigated the barriers that teachers face when using technology in their classroom in primary schools, and why some overcame obstacles while others did not. Semi-structured interviews and observations were used for the purpose of this research, which were undertaken with three mathematics teachers from school A which used technology, and the other three from school B, which did not use technology. The researcher observed each teacher 45 times separately, 45 minutes each time, over a period of three months. The three teachers in school A were observed during the first 45 days, and the other three were observed for another 45 days. The researcher found from the interviews' responses of all six teachers and the consequent observations, that the head teacher's support was the main reason behind their decision to overcome or not overcome the obstacles they face when using technology to help students with difficulties in mathematics. The principals of both schools played a crucial role in managing the challenges they faced with technology. This became evident when the head master of school A helped the teachers in overcoming the obstacles they faced when using technology by training teachers and through technical support, which reflected positively on teaching and learning mathematics, leading to a continued and enthusiastic use of technology. On the other hand, the head teacher in school B did not help or support his teachers in providing technology in school, nor help with overcoming the challenges they faced with technology, which reflected negatively on their enthusiasm to continue to overcome barriers such as the provision of technology in the school, and the lack of training and technical support, in spite of their beliefs that the technology has a positive impact on teaching and in the learning of students who have difficulties in mathematics. This study concludes with recommendations regarding future research in this area.

Declaration

This thesis is as a result of my research and has not be been submitted for any other degree in any other university.

Copyright

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The structure of chapter one

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1.4 Research Questions	1.5 Methodology	1.6 Ethical considerations	1.7 Theoretical Framework
	1.8 The research boundaries	1.9 Organisation of the thesis	

1.10 Definitions of terms

Chapter One

Introduction

1.0 Introduction

There are some students who have difficulties with mathematics subjects at primary schools in the Kingdom of Saudi Arabia. Mathematics learning difficulties is a generic term referring to those pupils "*who learn but misconceive, find prescribed steps hard to understand, pattern development, visualizing as well as misunderstanding structures*" (Chan, 2009, p.v.). It is therefore not surprising to note that many students perceive mathematics as a difficult subject, as it consists of many areas that continue to develop in an increasingly complex way (Wendling & Mather, 2009). However, when technology is integrated with teaching techniques, it can promote the translation of mathematical concepts from one mode into another, thereby making ideas more tangible (Suh, Moyer, & Heo, 2005).

In Principles and Standards for School Mathematics (2000), the National Council of Teachers of Mathematics (NCTM) states "*technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning*" (p. 24). Additionally, several research studies have concluded that, by utilising means of technology strategically, acquisition of mathematical processes and abilities can be facilitated, and advanced mathematical competences, including problem solving, reasoning, and validating, can be developed (e.g., Gadanidis & Geiger, 2010; Kastberg & Leatham, 2005; Nelson, Christopher, & Mims, 2009; Pierce & Stacey, 2010; Suh & Moyer, 2007).

Therefore, the Saudi Government has made significant efforts made to improve the education system of the nation, with one of the goals more effective use of technology in mathematics education. These efforts have included a continuous rise in the educational budget with SR210 billion ($56 billion) for educational development in the 2014 budget, which was double the budget of SR105 billion ($28 billion) in 2008 (Ministry of Finance, 2014).

However, there are still some teachers who face obstacles in using technology, and some of these teachers try to overcome these barriers, whilst others do not succeed in this the challenge. Overall the results are not as impressive as expected by the officials, which has been demonstrated in a number of ways. For example, according to the study of TIMSS (2007), Saudi Arabia got an average score of 4 along with 8 science samples was about 403 less than the international average and also below many other countries that have almost similar cultural and economic context (Mullis et al., 2008). Furthermore, there has been a discussion on education which is linked to the process of learning. Also, this discussion has been making a contribution to the comprehensive results and the grading within the TIMMS study.

Therefore, the aim of this study is to improve the quality of teaching mathematics in these two schools in the Kingdom of Saudi Arabia through investigating and understanding the barriers that teachers face when using technology in their classroom in primary schools, and particularly why some overcame obstacles and why others did not.

1.1 Statement of Problem

Great efforts have been made by the Saudi Arabian Government in order to improve the education system of the nation, which has included a continuous rise in the educational budget. We are aware that the bedrock of both the success and the strength originates from the development of the country with perception and knowledge. Therefore, to meet this goal, the Kingdom has been looking for methods to improve, upgrade, as well as develop the educational system along with its outcome (Ministry of Education, 2004). Thus, it has become of utmost importance to materialize the objectives and then turn them into national plans, as well as specialized work programs. At the same time, to recognize such goals, there is need of an Educational System (Ministry of Education, 2004). Let us take, for example, the Ten Year Plan 2004-2014, released by the Saudi Ministry of Education, which covered development of infrastructure so that the technology could be easily implemented in the education (Ministry of Education, 2004).

In addition, the government of the Kingdom has allotted SR204 billion ($54.4 billion) for the educational development in the 2013 budget, increasing from SR168 billion ($44.80 billion) in 2012 and SR150 billion ($40 billion) in the year 2011. The government has been focusing on investment in human capital after looking at the fact the expenditure on education has tripled since the year 2000. The budget covers construction of 610 new schools, while 3,200 new schools are already being constructed at present (Ministry of Finance, 2014).

Conversely, the results are not as impressive as expected by the officials, which has been demonstrated by a number of Kingdom's professionals' analysis. For example, in the year 2007, the Kingdom of Saudi Arabia joined with other 57 countries and took part in the Trends in International Mathematics and Science Study (AL Shannag, Tairab, Dodeen, & Abduel-Fattah, 2012). This particular international assessment, which was conducted under International Association for the Evaluation of Education (IEA), has been designed continuously to enhance the teaching as well as learning in science and mathematics for all the students all over the globe via empirical finding, so as to highlight the varied similarities, differences, and to inform the educational policies between various countries so that the countries that are participating could learn from one another in terms of relation and quality of student learning (AL Shannag et al., 2012).

In fact, the teachers have become more or less the main focus of TIMSS and put extra effort on their various roles as well as their responsibilities in order to achieve three dimensions. Precisely, the main dimension of TIMSS studies is organized by the teachers. This became very much clear with the data that was collected in TIMSS with the help of "Teacher Questionnaire" that took care and examined numbers of issues associated with the opportunities provided as well as the implementation of curriculum for the student learning, like educational practices, assignment of homework, qualifications, and also the ambience of the classroom (AL Shannag et al., 2012).

According to my previous discussion, Saudi Arabia is considered one of those countries that allotted a major part of its budget in education for developing the future of the country in a prospective direction. According to the study of TIMSS (2007), Saudi Arabia got an average score of 4 along with 8 science samples was about 403 less than the international average and also below many other countries that have almost similar cultural and economic context (Mullis et al., 2008). Additionally, a discussion on the education which is connected with the learning procedure has been in progress within the nation. This has been making a contribution to the inclusive results and position within TIMMS research study.

There is a need to take a careful look into the practices of teaching and variables that are related to teachers to devise meaningful conclusion so that a plan on ways to improve the achievements of students can be formed. This has been suggested by recent studies which conducted secondary analyses of mathematical suggestion of the Saudi Arabia sample (Dodeen, Abdelfattah, Shumrani, & Abu Hilal, 2012) and Saudi Arabia science teachers' assessment practice (Al-bursan & Tighezza, 2013).

Variables related to qualifications, professional development activities, and teaching practices in Saudi Arabian teachers differed significantly from Taiwanese mathematics teachers (Dodeen et al., 2012). Between science teachers in Saudi Arabia and South Korea, nearly identical results were discovered by Al-bursan and Tighezza (2013), which showed that assessment practices used by Korean teachers were more differentiated than that of the Saudi Arabian teachers.

TIMSS findings showed that a significantly higher average score (567) was achieved by grade 8 students of Singapore in comparison to those from Saudi Arabia, whose scores were quite mediocre, (Al Shannag et al., 2012). Naturally, one would question whether the differences in the quality of the teachers affected students' performance. Although their influence on student achievement has been a matter of debate, student learning being impacted by teachers has been established beyond doubt. It is true that schools and teachers can make a considerable difference to student attainment, and it is this fact that underpins relevant discussions. The secondary analysis of TIMMS indicates that variations in teacher distinguishing credentials, planning, classroom methods, and professional progress attained may account for the variations, which exist in student attainment, between these two countries (Al Shannag et al., 2012).

The policy makers of Saudi Arabia can use these comparisons to make decisions regarding the mathematics curricula and the process of teaching and learning to bring about positive change. Therefore, in this study I will investigate the barriers that teachers face when using technology, and why they overcame obstacles and why not, and I focus on technology because Piaget established that children initially acquire tangible concepts and advance to abstract concepts afterwards (Piaget, 1970a). Also, according to analysts, teachers perceive their task of furthering the knowledge and abilities, which their students have already developed, when abstract concepts are rendered more concrete by technology. Such knowledge and abilities emphasise the links between various mathematical concepts, form links between abstract conceptions and tangible realities. This enables typical misinterpretations to be tackled and more sophisticated concepts to be presented (Bransford, Brown, & Cocking, 1999; Roschelle, Pea, Hoadley, Gordin, & Means, 2000).

1.2 Study Objectives

The study aims to help improve the quality of teaching mathematics in these two schools in the Kingdom of Saudi Arabia by investigating the obstacles to the use of technology in teaching mathematics. The specific objects can be classified as:

1. Identification of obstacles to the use of technology in primary schools in order to help students who have difficulties in mathematics.
2. Understanding why some mathematics teachers are overcoming the obstacles they face when using technology to benefit their students.
3. Understanding why some mathematics teachers who do not use technology with their students do not try to overcome the obstacles that prevent them from using technology.
4. Determining whether the use of technology has a positive effect on students who face difficulties in mathematics.

1.3 Significance of the Study

1. The effects of the application of technology in primary schools to students who have difficulty understanding mathematics have been studied by this author during the pursuit of a master’s degree. It was discovered that although the effects of technology use in teaching of mathematics were largely positive, there are some obstacles that teachers face while using technology. Therefore, the decision was made to investigate the obstacles that are faced by mathematics teachers and reduce the separation between teachers and use of technology in schools to the advantage of students.
2. The study aims to encourage technology use in the schools of the Kingdom of Saudi Arabia to help teachers to help pupils who have difficulties in mathematics so that desired outcomes may be achieved and their abilities may be advanced.
3. To lower the difference between the amount of money being expended on the education of pupils and the poor of results in mathematics.

4. Because of the fact that individual differences cannot be ignored and impacts the performance of students, the topic has an undoubted significance. However, school environment does exaggerate individual differences, though they have no role in its creation. If expectations do not take into account the difficulties of some students, they will suffer and be discouraged (Dowker, 2004).
5. The groundwork for future learning and future skills are laid by primary education because the skills and values that are instilled there are absolutely foundational. Primary education serves as the base on which students build upon during further schooling and hence the choice of elementary school is important.
6. This study is important because it will be addressing the impediments that mathematics teachers face when using technology to assist students with difficulties in mathematics. The results that this study will bring up are expected to assist the educational supervisors for these two schools in reaching a clarification regarding the hurdles that face teachers who teach mathematics and help them overcome those problems.
7. In areas such as application of modern technology in mathematics education, this study can pave way for more research and studies in the future.

1.4 Research Questions

1. Why are some mathematics teachers overcoming the obstacles they face when using technology to benefit their students?
2. Why do some mathematics teachers not succeed in overcoming the obstacles that prevent them from using technology to benefit their students?

1.5 Methodology

1.5.1 Data Collection Method

This case study was conducted at two primary schools in Saudi Arabia, with three male mathematics teachers in school A, who use technology with their students who have mathematics difficulties, and three other teachers in school B do not use it with their students.

Each one of these six teachers were interviewed and asked general questions about the use of technology (Part 1). Each was then observed in their classrooms for 45 times, 45 minutes each time, over a period of three months, and, finally, every teacher was individually interviewed and asked specific questions to address the research questions (Part 2).

Interviews and observations were chosen as techniques for the purpose of this research and because data collected through interviews and observations can be compared. In addition, observations are crucial to see the effect of technology on the students' mathematical learning. However, the observations may not be enough, as there remain the need to investigate and understand the barriers that teachers face when they use technology, and why they overcame obstacles or why not.

1.5.2 Data analysis

This section describes in summary how data was analysed. Firstly, all interviews were recorded and transcribed verbatim after each session. The each transcript, interview data and observation notes were read and re-read. Secondly, thematic coding was used (underlining the text in different colours) and matched data in categories separately which allowed reduction and synthesis of large quantities of information. Thirdly, all the identified commonalities were divided into themes, and supported with quotes, because "*qualitative researchers use analytic induction strategies to present the results*" (Bogdan & Biklen, 2007, p.32).

1.6 Ethical considerations

The study was conducted in accordance with the British Educational Research Association Revised Ethical Guidelines for Educational Research (2004) with ethical approval given by the School of Education's Research Ethics Committee at Durham University.

1.7 Theoretical Framework

The theoretical frameworks adopted to undertake this research include the Concerns-Based Adoption Model (CBAM) (CBAM: Hall & Loucks, 1978; Sashkin & Ergermeier, 1993) and the Technological Pedagogical Content Knowledge (TPCK) (Shulman, 1986; Mishra & Koehler, 2006). To understand the challenges those teachers face when using technology, CBAM is adopted. The term TPCK is used to describe the knowledge that is required by the teachers for effective integration of technology into educational practices. This study uses TPCK as a framework to understand mathematics’ teachers needs so that they can overcome the hurdles of introducing technology in classes.

1.8 The research boundaries

These can be summarised as follows:

1- This study focused only on government primary schools in the east of Saudi Arabia. Consequently, it may not be possible to generalise the results countrywide. However, the researcher believes that this city was a good place to conduct this study, because it has a big population which is drawn from different parts of the Kingdom of Saudi Arabia.
2- The sample is limited to male mathematics teachers, because access to schools with a female complement for a male researcher is extremely limited.

1.9 Organisation of the thesis

This thesis has six chapters, each of whom has a role to play within the whole structure.

The introduction to the study is presented here in chapter one, after which the research problem follows. Additionally, the research objectives, general significance of the study, research questions, summary of methodology, ethical considerations, theoretical frameworks, the research boundaries and definitions of terms are given.

In chapter two, a background to Saudi education is presented. Social aspects such as religion and culture, educational system, and the educational budget of Saudi Arabia from 2008 to 2014 are included in this chapter. Among other things, King Abdullah bin Abdulaziz education development project (Tatweer), the use of technology in the Kingdom of Saudi Arabia, learning difficulties in Saudi Arabia, and, finally, about low Saudi Student achievement in mathematics also have been discussed.

The literature review is presented in chapter three. The concentration here is on the literature that provides an overview of the learning theories along with common misconceptions and difficulties of learning mathematics that students have. The chapter also discusses the role of technology in the teaching and learning of mathematics, and, finally, barriers to using technology in the teaching and learning of mathematics.

The methodology adopted is discussed in chapter four. This explains the approach of research and the reasons for which it was selected, along with an account of the construction of interviews and observations. The ethical considerations that were raised in the study also are given.

The data analysis that includes the interviews and observations of teachers is presented in tables as well as in a detailed manner in chapter five.

Chapter six discusses (a) all the results obtained from interview questions and researcher's observations, and (b) the theoretical frameworks guiding this study. In addition, the chapter moves to a summary of the results, the contribution of the study, reflexivity, limitations of the study, recommendations, and suggestions for further research, and closes with the study conclusion.

1.10 Definitions of terms

1.10.1 Mathematical learning difficulties

The term mathematical learning difficulty is usually used with those students who have mathematical achievement test scores of less than the 35th percentile (Gersten, Jordan, & Flojo, 2005). Generally, mathematical difficulties refers to those students who fail to reach the level commensurate with their age, such as Level 1 at age 7 or Level 3 at age 11, as a great deal more effort is required of them to perform successfully; for some students, mathematics does not come automatically, and they may need more time and energy on the part of the teacher to pass through their difficult stage in mathematics (Dowker, 2004). This research focuses on this type of learning difficulty in mathematics within primary education.

1.10.2 Obstacles

An obstacle is something that prevents mathematics teachers from using technology to help students with difficulties in mathematics.

1.10.3 Technology

Technology is a set of appropriate tools that include computers, IWBs, TVs, videos, projectors, and software; they are meant to enhance teaching and learning. This is what the researcher means by "technology" in the current study. In my study, I noticed that some teachers used an IWB, Number Race software, the PowerPoint program and a camera in teaching and learning mathematics. Actually, I did not make the choice of which technology to include in my study but I noticed these types during my observations of these teachers. I think other schools use IWB because this type of technology is very popular in elementary schools in Saudi.

1.10.4 The interactive whiteboards (IWB)

The IWB system consists of these major components: projector, computer and display screen (Wood & Ashfield, 2008). One of the reasons for using IWBs as tool for education is because it offers the opportunity to incorporate a wide range of multimedia resources into one lesson; these include sound, pictures, written text, video clips, CD-ROMs, software packages and using the Internet (Ekhaml, 2002; Glover & Miller, 2001). A typical classroom IWB has a large touch-sensitive screen, making it highly visible (Smith, Higgings, Wall, & Miller, 2005), and it has many features that make it easy for students to write on using their fingers; anything written on it can be saved and revisited in subsequent lessons (Solvie, 2007). In other words, an IWB has the ability to record the actions taken by students on the board, affording the teacher the opportunity to measure each student’s understanding of the lesson, and then to address any difficulties a student may be facing.

1.10.5 Attitude

Brehm, Kassin and Fein (2002) define an attitude as “*a positive, negative, or mixed reaction to a person, object, or idea*” (p.179). According to Simpson, Koballa, Oliver, and Crawley (1994), it is possible to define an attitude as a particular perception of whether an individual likes or dislikes something.

The structure of chapter two

The purpose of this chapter is to provide some background for this study, which divided into seven main sections as follow:

2.0 Introduction

2.1General overview of the Kingdom of Saudi Arabia

2.2 Education budget in the Kingdom of Saudi Arabia from 2008 to 2014

2.3 King Abdullah bin Abdulaziz Education Development Project (Tatweer)

2.4 The use of technology in the Kingdom of Saudi Arabia

2.5 Learning difficulties in Saudi Arabia

2.6 Summary

Chapter Two

Education and technology in Saudi Arabia

2.0 Introduction

The purpose of this chapter is to provide some background for this study. It includes a general overview of the Kingdom of Saudi Arabia; this section describes the site of current study which includes its geography, economy, cultural and social life of Saudi Arabia. All these factors are related to this research because they influence both education policy and education practice in different ways. Economically, the fact that oil accounts for 90% of the country's gross domestic product (GDP) makes things such as science, engineering and technology mathematics important in the country's education strategy. Geographically, there are very different regions and needs in Saudi Arabia, a fact that makes it difficult to have a centrally-driven policy; we can see that in the Tatweer project, where they try to devolve more responsibility to the local region's schools. This is followed by the education budget in the Kingdom of Saudi Arabia from 2008 to 2014, the King Abdullah bin Abdulaziz Education Development Project (Tatweer), the use of technology in the Kingdom of Saudi Arabia, and learning challenges in Saudi Arabia.

2.1 General overview of the Kingdom of Saudi Arabia

Saudi Arabia (KSA) is a Middle East country located between the Red Sea and the Persian Gulf, and sharing its northern boarders with Jordan, Iraq, and Kuwait and its southern boarders with Oman, Yemen, and the United Arab Emirate (UAE). It also shares its eastern boarders with Qatar (Ministry of Economy and Planning, 2010).

Riyadh, located in the middle of the Kingdom called Najd is the capital of KSA. Saudi Arabia is made of five regions divided into thirteen zones. The Central Province is called Al- Wosttah while the Western Province is known as the Hijaz region and called "Algharbiah" as well as along the Red Sea where the holy cities of Makkah (Mecca) and Madinah (Medina) together with Jeddah, which is a port city, and Taif, which is the country's summer capital. The Eastern Province is known as the the Al-Sharghiyah region while the Southern and Northern Provinces are known as the Al-Janoob and Al-Shamal region respectively (Al-Zahrani, 2010). The study for this project was conducted in the Eastern Province shown in Figure (2.1).

Figure (2.1): Map of the Kingdom of Saudi Arabia

The weather varies from one region to another in Saudi Arabia because of its vast land (Alsharari, 2010). Its temperature is the same with what prevails in other Gulf States. In Jeddah, all year round the weather is often hot, with temperature sometimes reaching as high as 48 degrees centigrade, and humid. In Riyadh, the temperature remains higher in the summer, but with a lower degree of humidity. Saudi Arabia has a more moderate winter, but with occasional heavy rains, particularly in the highlands. The official language of Saudi Arabia is Arabic which prompted the interview questions used for this project to be prepared in Arabic language. Nonetheless, English is optionally utilised in the country as a minor language, especially in the health sector as well as in business and international matters (Ministry of Foreign Affairs (MOFA), 2009). The population of Saudi Arabia was 27.5 million in 2010 with a yearly growth rate of 2.3% considered to be among the world's highest rates (Ministry of Economy and Planning, KSA, 2010). Accordingly, it is anticipated that the Saudi population will grow two-fold in the 50 years to come, which will increase the already high percentage of youth: 65% of Saudis are under 30 (Ministry of Economy and Planning, 2010).

KSA's main source of revenue is hydrocarbons and its subsidiary products as oil accounts for 90% of the gross domestic product (GDP), of the country whose oil reserves are the highest at the world level - 26% of the global reserves (Ministry of

Economy and Planning, 2010). In spite Saudi Arabia great wealth, the country is starting to explore other natural resources such as natural gas together with minerals and precious metals to help increase its revenues (Royal Embassy, 2010). The system of government in KSA is a theocratic monarchy, and the royal family is ruling the kingdom according Sharia Islamic laws based on the teachings of the Moslem's Holy Quran. The dominant religion in the country is by far Islam with certain rights such as right to life, dignity, and education accorded to every citizen in accordance with the Sharia laws (Alhageel, 1996; Alsenbul, 1996).

KSA is unique and special for being as important site of Islam and for hosting two holy mosques, one located in in Makkah which every Muslim all over the world faces while performing the daily prayers five times a day. Also, Muslims who can afford it are encouraged to make the annual pilgrimage to Makkah at least once in a lifetime for the ritual Islamic practices of Omra and Haj that involve prayers in Makah. The statement of Cameron, Cowan, Holmes, Hurst, and McLean (1983) two decades ago is still true: Saudi Arabia represents the hub of Islam and it acts as the protector of the holy sites, and yet the impact of religion is not directly or evidently felt anywhere. In theory, the religion of Islam and the state are the same with Saudi Arabia's constitution based on the Quran. The country practices Sharia law which comprises in its totality, the Islamic religious and moral laws with the Hanbali School being the principal school that is being adhered to. However, other three major recognized and respected schools of Islam exist (Cameron et al., 1983).

2.1.1 Culture and Social life

The kingdom of Saudi Arabia operates a monarchy system of government with the constitution based on the Holy Book together with the Quran and Sharia Law. The king is the head of the executive and administrative bodies of the government made up of the Council of Ministers (Oyaid, 2009). Islam is the essential determining factor in Saudi culture. In fact, all social and cultural principles of life of the people are revolved around the Muslim religion and religious identity (Oyaid, 2009). In Saudi Arabia, religious morals ranging from personal relations to tribal and values in the extended family system all as counterpart of a complex system of interlocking commitments which is assigned by the Quran to all individual Muslims, take precedence of all other things (Oyaid, 2009).

The Moslem religion encompasses all the different details in the lives of the people and the places they live, with special emphasis on their education because Islam looks at education as a religious duty that is bound by all men and women to fulfil (Oyaid, 2009). As stated by Al-Salloom (1989), under Islam all Muslims – men and women – are obliged to learn. This obligation, whereby education is elevated to the level of a religious duty, forms the key pillar on which education in Saudi Arabia is based. It is the basis for the country's educational responsibilities, according to which the Saudi man or woman do their obligations towards themselves, their society and religion. Education in Saudi Arabia is thus inherently rooted in Islamic education which first began at mosques and was followed by the creation of schools and universities.

2.2 Education budget in the Kingdom of Saudi Arabia from 2008 to 2014

<table>
<tr><th>Section</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th><th>2013</th><th>2014</th></tr>
<tr><td>Building new schools</td><td colspan="7">The number of schools under construction steadily dropped from 2,074 schools in 2008 to 465 schools in 2014.</td></tr>
<tr><td>Schools currently under construction</td><td colspan="7">The number of schools being constructed steadily dropped from 4,352 schools in 2008 to 1,544 schools in 2014.</td></tr>
<tr><td>Rehabilitation of school buildings</td><td colspan="7">Since 2008, each year 200 school buildings are rehabilitated, except in 2014, when 1500 schools were refurbished.</td></tr>
<tr><td>New colleges</td><td colspan="7">Continuing to open new universities and colleges.</td></tr>
<tr><td>New technical institutes to be opened</td><td colspan="7">There are appropriations allocated for the construction of new vocational and technical colleges and institutes.</td></tr>
<tr><td>The scholarship programme</td><td colspan="7">Continuing the scholarship programme.</td></tr>
<tr><td>Tatweer Project</td><td colspan="7">Continued implementation of King Abdullah Public Education Development Project (Tatweer) which is costing SR 9 billion.</td></tr>
<tr><td>The ongoing National Plan for Science and Technology</td><td colspan="7">The implementation of the National Plan for science and Technology costing SR 8 billion.</td></tr>
<tr><td>Total expenditure (SR)</td><td colspan="7">There are a continuous rise in the educational budget with SR210 billion ($56 billion) for educational development in the 2014 budget, which was double the budget of SR105 billion ($28 billion) in 2008.</td></tr>
</table>

Table (2.1): Summary of the education budget in Saudi Arabia from 2008 to 2014

The table above shows that the government of Saudi Arabia has made great strides in its effort to improve the country's educational system. This has resulted in the continuous increase in the country's allocation of funds for education in the national budget. Indeed, one of the reasons for the significance of this study is that it will lower the difference between the amount of money being expended on the education of pupils and the poor of results in mathematics. Therefore, the researcher tries to provide a clear and detailed picture of the amount of money paid by the government each year during the period 2008-2014, in order to improve education. Please see appendix (14) for more details.

2.3 King Abdullah bin Abdulaziz Education Development Project (Tatweer)

Saudi Arabia is a very good example of a third world country that takes the education of its citizens which is based on the concepts of the Islamic cultures very seriously. These facts have been demonstrated in the budget outlays already presented in the above section. The general objective is to have an efficient and effective education system, which meets the religious goals and the economic and social needs of the country. It will also helps reduce the illiteracy rate of the adult population of Saudi Arabian citizens (Alhogel, 2003).

In the beginning of 2007, the King Abdullah bin Abdulaziz Public Education Development Project (Tatweer) was inaugurated by the Saudi Council of Ministers to counter the continuous criticisms levelled against the Saudi school curricula, and to answer the calls of the stakeholders to overhaul the entire school system (Kamal, 2012). The key criticisms of the Saudi school curriculum include the fact that some aspects are missing from the traditional curriculum, such as creative and practical work. In the traditional view, the teacher feeds the students with the required information from the textbook and then sets the questions for the next examination from the previous one (Alkahtani, 2015). Testing does not include any questions or items designed to show creativity or thinking. The teacher's job is to get the students to listen and to transfer the information from the blackboard to their files, and ultimately to their test or exam paper. The traditional curriculum does not help to raise the students' level of thinking, nor encourage them to be critical, creative, or to express their opinions and explain matters which would develop their reasoning and problem-solving skills, through making presentations to their fellow students (Alkahtani, 2015).

Tatweer, an Arabic term that means "just reform" takes cognisance of the prior weak reform programmes. The aim of Tatweer, this time, is to see that a comprehensive educational development programme is put in place in public schools operating within the Kingdom of Saudi Arabia (Hakami, 2010). Such aims call for embarking on projects that would improve the education system in Saudi Arabia through greater utilisation of modern technology, development of school curricula, requalification of teachers, and the reforming of the school system (Kamal, 2012). The General Manager of Tatweer Dr. Ali Al-Hakamihad further stated that the goal of Tatweer is to make students become proficient in the areas of mathematics, science, and computer science skills. Such programme would encourage students to learn more in order to gain better communication skills as well as become more flexible and innovative in the teaching environment (Chicago forum: Private sector to help reform Saudi education system, 2012). The Tatweer programme has a projected budget of $ 2.4 billion and is projected to function for a duration of six years from 2007 to 2013 (Kamal, 2012). The project functions independent of the Ministry of Education and is directly being supervised by the king which further enhances its strong authority and independence (Kamal, 2012).

Traditionally, the education system in Saudi Arabia was extremely centralised, but Tatweer's key goal is to decentralise this system by delegating more powers to schools and educational departments (Hakami, 2010). The focus of Tatweer is particularly on the needs of the learners and the adoption of the learner-centred approach. Tatweer differs from previous reform initiatives, in that it initiated a complete overhaul of the education system in Saudi Arabia. In addition to the improvement of curricula, other education-related aspects are involved, for instance the enhancement of the standard of education, professional improvement, and the enhancement of the school environment with a view to encouraging learning (Hakami, 2010).

2.4 The use of technology in the Kingdom of Saudi Arabia

In 1954, the audio-visual section (which involves TV and radio) started to be incorporated into the education system in Saudi Arabia. (Kensara, 1987). This section was further developed and reorganised in 1964 to become known as the Department of Educational Aids and the Science Laboratories (Abuazma, 1991). Starting from 1970s, the KSA began focusing on technology especially in the field of education (Abuazma, 1991).

Therefore, a lot of plans have been put in place in these last few years for the promotion, development, and coordination of efforts with regards to lifelong learning to teach students with the aid of technology. For instant, to honour the agreement reached between the KSA Ministry of Education and the Indiana University Foundation, the Indiana University came up with a comprehensive plan that would develop audio visual technologies in the form of television and radio in the Kingdom of Saudi Arabia (An Operational Plan for a National Educational Technology Program, 1975). The aim of designing this plan was to coordinate the educational technology for future policies and objectives of the government. Such objectives are the following:

1- Launching a National Centre for educational technology for the purpose of developing, producing, and distributing classroom teaching aids, researching on curriculum, and the testing of equipment and programme.
2- Start the trial phase of the educational television project;
3- Initiate simplified language-laboratory system to be used in the teaching of English language at the secondary school level.
4- Create an experimental audio system for the teaching of Arabic language at the elementary school level.
5- Design an integrated classroom facility to handle both theory and practical learning and introduce in secondary schools on a pilot basis.
6- Inaugurate an experimental schools where equipment and educational approaches can be tested.
7- Introduce the use of mobile and prefabricated classrooms for the school expansion programme (The Ministry of Planning, 1976).

The government threw its support to these objectives since it was lucky to enjoy enormous financial wealth as a result of high oil prices in the world market (Abuazma, 1991). The government came with its full and total support since it has realised that oil will not flow forever, and that the cornerstone of development for any nation lies in education. It is with this regard that the Saudi government made a bold decision to earmark some amount coming from the oil revenues for these objectives (Abuazma, 1991).

Moving to the use of computer, first introduced at the Ministry of Education, computer became a useful tool for storing and processing information regarding students, faculty, and administration related records (Alshumaim & Alhassan, 2010). Back then, computers were utilised to help with multiple activities related to teaching approaches;

for example, they were used to aid in the preparation of courses and the creation of documents, as well as the production of books and management. This is in addition to other activities connected with education. Computers were also increasingly utilised in hard sciences, with the aim of assisting scientific experiments (Alshumaim & Alhassan, 2010).

More recently, the Ministry of Education began an expanded programme whereby primary schools were equipped with computer laboratories. However, this expanded programme was discontinued because there were not enough teachers to handle the computer related subjects (Alshumaim & Alhassan, 2010).

After the introduction of the computer, two tenders have been given by the Ministry of Education (MoE) in Saudi Arabia to SMART Technologies to provide a total number of 9,000 interactive electronic whiteboards and relevant software. At the level of the Middle East, this represents the biggest single sale of interactive whiteboards so far. What will be supplied by SMART include 9,000 SMART boards as well as licences for collaborative learning software related to SMART Notebook (Sutton, 2013). The deployment of the materials would be led by Saudi official distributor Obeikan Education and the materials would be sent to 6,500 public school classrooms as well as to 2,500 computer laboratories. The implementation of the programme would include the training of schoolteacher and the development of professionals in the field of computer science. The Ministry of Education is planning to provide interactive whiteboards in 50,000 classrooms in the next three years (Sutton, 2013).

As discovered by Abu Ras (1979), the percentage of teachers at elementary schools in Saudi Arabia who were au fait with the use and operation of a variety of modern equipment was less than 3%. Truly, the educators who could utilise teaching materials that were not costly – such as charts, overhead projectors, and graphs – in the class were less than 30%. Al-Hussain (1983) indicated that the technique of lecturing was the only one employed in education at schools in Saudi Arabia. The government of Saudi Arabia, nonetheless, has one key goal in relation to its education policy: training individuals as fast as possible in using facilities and equipment available in the country. Mallakh (1982) reiterated that

> *Eighty-three percent of the total financial resources allocated to the development of human capital will be spent on the expansion of facilities at all four levels of the*

Saudi Arabian educational system: elementary, intermediate, secondary, and graduate (p.185).

2.5 Learning and special educational needs in Saudi Arabia

The term “learning difficulties” is not clearly defined in Saudi Arabia. The term “learning disabilities” is employed by specialists in the area of learning disabilities to refer to those school children with learning difficulties in relation to certain school subjects and with ‘apparently’ mediocre intelligence and an underlying deficit, and supposed to be a result of central nervous system dysfunction (Al-Hano, 2006, p.176). According to Hussain (2007), about 5-10% of students in Saudi Arabia have learning difficulties. This percentage, nonetheless, may not represent the real situation, given that there are no adequate instruments of evaluation. At schools in Saudi Arabia, it is the duty of regular classroom teachers to refer students for a check (Hussain, 2007). Students identified as having learning difficulties are then assisted by professionals in the area of learning disabilities. Learning disabilities are treated as disabilities of a minor nature; and students with learning disabilities receive their education within the general education environment with normally developing peers. However, additional assistance (for instance, a resource room) is supplied when needed (Al-Ajmi, 2006). See Section 3.5.4, which is about the cultural influence on mathematics, as part of the literature review chapter.

The first institution to provide a programme for student teachers interested in majoring in learning difficulties was King Saud University, in 1991. A Learning Difficulties Day – on 3 May 2009 – was introduced by the Ministry of Education, together with a “I Know My Difficulties” campaign. In 2010, the campaign was “Yes, I Can Learn”, and the following year it was “Learn About My Difficulties So We Can Defeat Them.” All schools were obliged join these campaigns which were designed to teach Saudis about learning-related difficulties. The goal of efforts to enhance awareness is to end the negative view held by society towards learning-related difficulties (Ministry of Education of Saudi Arabia, 2011).

The Ministry of Education of Saudi Arabia (2001) assessment procedures are identical to those of Canada. These are the procedures:

- It is important that parents give their consent before diagnosing a child’s condition, and before making any decision.
- Parents should participate in preparing, evaluating and tracking the educational plan of an individual child.
- Parents or the student's guardians are encouraged to pay visit to the institute or the school to become familiar with the recommended programme for the child.
- All student’s and his family’s information must be kept confidential.
- All information given to parents regarding their child must be in simple language tin order that everything should be understood clearly.
- A student’s family has the right to demand for a re-diagnosis if they doubt the accuracy of the initial diagnosis (Ministry of Education of Saudi Arabia, 2001).

2.5.1 Low Saudi Student Achievement in mathematics

To efficiently assess the quality of the education system in Saudi Arabia, one way is to draw a comparison between the performance of Saudi students and that of other Gulf states and world countries (Hussain, 2007). One comparative gauge of student achievement was obtained by Saudi Arabia in 2003 after the participation in the Trends in International Mathematics and Science Study (TIMSS) (Hussain, 2007). Saudi Arabia has not partaken in other international student achievement-related quantitative research studies, for instance the The Program for International Student Assessment (PISA) and the Progress in International Reading Literacy Study (PIRLS). Therefore, the country does not have any other comparative sources to assess the development of students, as compared with their peers around the world (Hussain, 2007).

Both Bahrain and Qatar partook in the TIMSS, in 2003 and 2007, respectively. Although these two Gulf states are considerably smaller in size than Saudi Arabia, there is a shared ethnic and Islamic cultural background between their populations and that of Saudi Arabia, and they also allocate huge parts of their budgets to education. In the relation to how Qatari students perform, no data are obtainable yet; however, 8th form Bahraini students score a total average of 401 points in mathematics; their Saudi peers, 332 points (TIMSS, 2003). Accordingly, Bahrain and Saudi Arabia are in the bottom in terms of mathematics’ scores; students in Saudi Arabia only outperform their South African and Ghanaian peers. Saudi Arabia and Bahrain thus have mathematics scores that are considerably below the global average score of 466 points (TIMSS, 2003).

2.6 Summary

This chapter focused on the presentation of an overview of the Kingdom of Saudi Arabia with regard to its population and economy, as well as its religion, culture, and the condition of its education system. Also, the allocations given to education in the Saudi Arabia's national budget, which have continuously increased year to year, have been enormous. These are indications that the government is giving its full support to the education sector as a way of keeping up with other developed nations. Also the King Abdullah Bin Abdul Aziz Public Education Development Project (Tatweer) is put into action with the aim of improving the education situation in Saudi Arabia through greater use of modern technology. Despite the Saudi government's effort to give adequate support to its students especially those encountering difficulties, the last section demonstrates that Saudi students achieve less in comparison with students of other Gulf States.

The structure of chapter three

This chapter will establish the current state of previous research in the areas relating to this dissertation, which divided into eight main sections as follow:

3.0 Introduction	3.1 Theoretical Framework	3.2Constructivism 3.3 Radical constructivism	3.4 The role of constructivism in mathematics education
3.5 The role of constructivism and behaviourism in technology	3.6 Defining mathematical learning difficulties	3.7 The Role of technology in teaching and learning mathematics	3.8 Barriers to using technology for teaching and learning mathematics

3.9 The research questions and conclusion to literature review

Chapter Three

Literature Review

3.0 Introduction

This chapter will establish the current state of previous research in the areas relating to this dissertation. The literature review will be divided into sub-sections that reflect the nature of the study being undertaken. The first section presents the theoretical frameworks for this thesis which include the Concerns-Based Adoption Model (CBAM) and the Technological Pedagogical Content Knowledge (TPCK). The second section provides the constructivism, and this is followed by the radical constructivist theory which is in the third section. The role of constructivism in mathematics education, and the role of constructivism and behaviourism in technology, which presents in the fourth and fifth sections respectively. The sixth section explores the common difficulties and misconceptions that students have in mathematics. In this section the researcher present a framework that maps the defining mathematical learning difficulties, misconceptions and difficulties in mathematics, sources of problems in learning mathematics and development and persistence of mathematics anxiety. The seventh section is about the role of technology in teaching and learning mathematics. It offers a brief summary of the history of using technology in mathematics education, how can we exploit the established role of technology in mathematics education to address difficulties in mathematics and how we should use it to its best advantage. This is followed by a summary of the barriers against using technology for teaching and learning mathematics. Lastly, the research questions and conclusion of literature review are given.

3.1 Theoretical Framework

The theoretical frameworks adopted to undertake this research include the Concerns-Based Adoption Model (CBAM) (CBAM: Hall & Loucks, 1978; Sashkin & Ergermeier, 1993) and the Technological Pedagogical Content Knowledge (TPCK) (Shulman, 1986; Mishra & Koehler, 2006). I did, in fact, give consideration to the Cultural Dimensions Theory (Hofstede) and also to the Diffusions of Innovations Theory. However, I decided not to utilise either of them since I am of the opinion that the choice of the Cultural Dimensions Theory (Hofstede) restricts my data so that only cultural facets are observed. Therefore, I decided not to use it, as I want to see other aspects. Consequently, I decided to use CBAM in this study, as a deeper insight of the change procedure in the possibility of the implementation of technology by classroom teachers. This permitted the concerns and levels of usage by the educators to be specifically identified. Additionally, it could allow teachers to enhance the application of technology and also to advance the forecasting of achievement as future endeavours are applied within the classroom.

In regard to the Diffusion of Innovations Theory, its principal advantage is that it supplies effective categorisation with regard to the adoption procedure. Nevertheless, Newhouse, Trinidad and Clarkson (2002) contend it to be restricted to an illustrative capacity because of its failure to "suggest how to help a person looking to make better use of some technological innovation" (p. 31). However, it advances a broadly recognised structure which has the ability to be successfully implemented in the description of the application of technology within the field of learning and teaching. In present-day study, this illustrative restriction is being focused on a greater dependence on CBAM in order to obtain recommendations to assisting people who have a desire to improve their technological integration standard.

In addition, this study uses TPCK as a framework to understand mathematics' teachers needs so that they can overcome the hurdles of introducing technology in classes. A brief review of both these theories will be provided by the following sections.

3.1.1 The Concerns-Based Adoption Model (CBAM)

Hall, Wallace, and Dossett (1973) produced an evidence-based conceptual structure on the basis of Fuller's (1969) concern theory. This conceptual framework is known as the Concerns-Based Adoption Model (CBAM), and it was first created at the University of Texas Research and Development Center for Teacher Education (Anderson, 1997). CBAM is considered a tool that is considered as essential for the empowerment of individuals who can bring changes in the settings of education. The model is also prominent owing to its all-encompassing approach, which focuses on both persons and institutions concerned with the process of change (Sashkin & Ergermeier, 1993).

Teachers who are introducing remodelled curriculum methods, or new educational systems, into their work are enabled by CBAM to adopt a model that assists them in gauging, defining, and interpreting the process of change, which they are undergoing (Anderson, 1997). In CBAM, concerns can be developed by teachers in various points during the course of the change process, and consequently they need individually-tailored help and advice (Hord, Rutherford, Huling-Austin, & Hall, 1987). The particular needs of each different user can be established through the model, which also aids facilitators in offering the appropriate help with regard to the particular requirements of each individual (Hord et al., 1987). Principal dimensions of the process, content, and assistance for teachers and other educators, in the course of executing change, are portrayed from the complex structure and methodology of CBAM (Hodges & Nelson, 2011). "*This description is accomplished by applying various schemes for classifying teacher implementation attitudes and behaviours, change management approaches, and change-facilitating interventions and roles*" (Anderson, 1997, p. 338).

According to Anderson (1997), CBAM is founded based on several assumptions that are (a) change is a process, not an event; (b) change is accomplished by individuals; (c) change is a highly personal experience; (d) change involves developmental growth in feelings and skills; and (e) change can be facilitated by interventions directed toward the individuals, innovations and contexts involved. Also, Newhouse (2001) stated that the CBAM model is composed of three key dimensions. The first is the Stages of Concern (SoC), the second is the Levels of Use (LoU), and the third is the Innovation Configuration (IC) (Newhouse, 2001). Newhouse (2001) stated that every aspect reflects a side of the process of change; SoC and LoU are mainly concentrated on the implementer, and the IC looks at the type of the innovation itself.

3.1.1.1 Stages of Concern

Hall, George, and Rutherford's (1977) defined concern as "*the composite representation of the feelings, preoccupation, thought, and consideration given to a particular issue or task*" (p. 5). Three distinct categories of concern, which include self, task, and impact, and there are seven distinct stages: awareness, informational, personal, management, consequence, collaboration, and refocusing are identified by the concerns framework see Table (3.1).

IMPAC	6	**Refocusing**	The individual focuses on exploring ways to reap more universal benefits from the innovation, including the possibility of making major changes to it or replacing it.

	5	**Collaboration**	The individual focuses on coordinating and cooperating with others regarding use of the innovation.
	4	**Consequence**	The individual focuses on the innovation's impact on students in his or her immediate sphere of influence. Considerations include the relevance of the innovation for students; the evaluation of student outcomes, including performance and competencies; and the changes needed to improve student outcomes.
TASK	3	**Management**	The individual focuses on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizing, managing, and scheduling dominate.
SELF	2	**Management**	The individual is uncertain about the demands of the innovation, his or her adequacy to meet those demands, and/or his or her role with the innovation. The individual is analyzing his or her relationship to the reward structure of the organization, determining his or her part in decision making, and considering potential conflicts with existing structures or personal commitment. Concerns also might involve the financial or status implications of the program for the individual and his or her colleagues.
	1	**Informational**	The individual indicates a general awareness of the innovation and interest in learning more details about it. The individual does not seem to be worried about himself or herself in relation to the innovation. Any interest is in impersonal, substantive aspects of the innovation, such as its general characteristics, effects, and requirements for use.
	0	**Unconcerned**	The individual indicates little concern about or involvement with the innovation.

Table (3.1): The Stages of Concern About an Innovation. From Measuring Implementation in Schools: The Stages of Concern Questionnaire," by A. A. George, G. E. Hall, and S. M. Stiegelbauer, p. 8. Copyright 2006 by SEDL.

When this theory is applied to these two schools' teachers in Saudi Arabia, who possess the knowledge and ability to utilise technology, these teachers would be graded at the lowest concern level of awareness, being a level of zero. There would be concern with the attitudes of teachers to the utilisation of technology. Furthermore, the expertise which these teachers require to utilise technology is connected to Stage Three Management. Therefore, the concerns of teachers regarding the results of utilising technology would be linked to Stage Five. This is because teachers at this stage are likely to have an interest in the effect of the new method on their students. Consequently, teachers at Stage Six who have great concerns, are likely to have more concerns regarding change than are teacher at the Zero Stage, who would unaware of this method. The CBAM Theory implies that the concerns of mathematics teachers are likely to be positioned anywhere between stages six and zero, on the basis of the degree of their concern regarding the utilisation of technology.

The SoC concept has been discovered by a number of research studies to be valuable in discerning the most profound sphere of concern of people concerned with innovation across a wide spectrum of areas, ranging from education to nursing. The SoC has enabled a comprehension of some of the qualities of potential adopters, such as age, gender, the level of training, disciplinary area and departmental support - which may have an impact on their most profound concerns. It has also supplied information for developing interventions capable of assisting the faculty and staff in the process of adopting an innovation (Adams, 2002; Atkins & Vasu, 2000; Rakes & Casey, 2002). Various research studies have revealed that the concerns of an individual will vary in intensity, according to a number of different aspects, such as the person's utilisation of the innovation, knowledge, and ability to apply innovation, as well as the involvement in innovation-related activities aimed at professional progress (Adams, 2002; Hall & Hord, 2001). Teachers' behaviours, beliefs and concerns should therefore be grasped by the heads of schools, particularly before and during the application of an innovation (Fullan, 1999).

CBAM, which concentrates on the comprehension of a person's behaviours, beliefs and sentiments, is an appropriate model for generating technological change for teachers (Adams, 2002; Gerstner & Snider, 2001; Newhouse, 2001). In addition, Marcinkiewicz (1994) supported the utilisation of concerns-based models in education-related technology research, given that in order to comprehend how integration can be attained, it is necessary that we scrutinise the educators and establish what leads them to employ computers; it is also necessary that study computers and identify what leads the educators to be interested in, or require, using them. In this case, the CBAM model will help teachers to remove their concerns, and problems related to technology, which is very important because Hall (1976), stated that an individual's concerns directly affect performance; and since concern levels correspond with levels of performance, lower level concerns must be removed before higher level concerns can emerge. However, the CBAM model helped me to identify teacher concerns but not school problems such as if a teacher does not have any technology, so I was still stuck. This means I cannot address teachers' concerns because the technological support is still one of the main concerns.

3.1.2 The Technological Pedagogical Content Knowledge (TPCK) Framework

TPCK, which has gained so much attention, has been constructed on Shulman's (1986) pedagogical content knowledge, or PCK framework (Angeli & Valanides, 2005). The nature of knowledge that is required by teachers and educators for the effective use of technology in education is identified through the use of TPCK, which serves as a theoretical framework for the given objective (Mishra & Koehler, 2006; Spiro & Jehng, 1990). The type of training and experiences for professional development that are provided to pre-service and in-service teachers could be modified if TPCK is used as a framework that can gauge teaching knowledge (Harris, Mishra, & Koehler, 2009; Mouza, 2011). To make the name easier to remember, TPCK framework was renamed TPACK. It also created a more unified structure for technology, pedagogy, and content, which are the three main kinds of knowledge that were addressed (Thompson & Mishra, 2007).

Bearing in mind the actions of teachers having an integrated knowledge of technology, content, and pedagogy, the recognition of the levels of thinking and understanding, TPACK standards provide a scale for comparison of mathematics teachers as they begin to develop an understanding of the TPACK concepts (Niess et al., 2009). Mishra and Koehler (2006) made a dissection of the basic TPACK framework in Figure (1.1) into its knowledge components, namely content knowledge (CK), pedagogical knowledge (PK), and pedagogical content knowledge (PCK). Additional components such as technological content knowledge (TCK) and technological pedagogical knowledge (TPK), which intersect with PCK, start emerging due to integration among the earlier mentioned components with technology knowledge (TK). It is necessary that teachers not only know the content of the subject they are teaching, but also the method by which the subject matter can be modified by using technology, as suggested by TCK. TPK has been defined as the knowledge of the existence, constituents and capacities of different technologies, in their application to teaching and learning environments, as well as – oppositely – how the employment of a certain technology could introduce change in teaching (Mishra & Koehler, 2006).

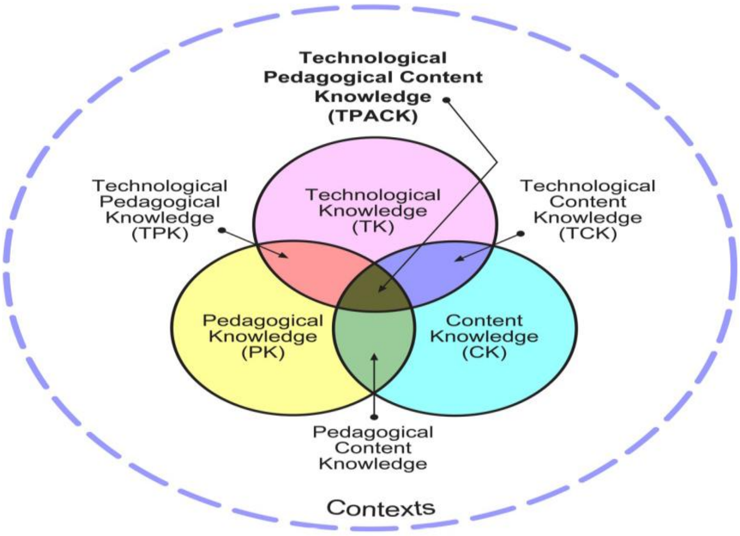


Figure (3.1): The components of the TPACK framework (graphic from TPCK - Technological Pedagogical Content Knowledge, 2010)

Teachers need a deep understanding of mathematics (content), the process of learning and teaching (pedagogy), and technology in order to be prepared to teach mathematics (Niess, 2006). It is also very important for them to have an integrated knowledge of these domains and their overlaps and the integrations between them. TPACK as a way of teaching focuses not only on particular concepts of mathematics, but also the way that it may be taught to students with the use of technology so that they may have the best possible understanding of it (Niess, 2006).

The objectives of TPACK are supported and shared by the National Council of Teachers of Mathematics (NCTM) in the year 2000 as a part of its Technology Principle standards, which was taken up in the new century. This principle states: "*Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning*" (NCTM, 2000, p.24). The types of experiences that are required by the teachers in order to meet the standards are understood and recognised by NCTM. If the creation of a positive environment that promotes collaborative problem solving, incorporates technology in a meaningful way, invites intellectual exploration, and supports student thinking is to be learned by teachers, they require such in experience in the first place (NCTM, 2007). The Association for Mathematics Teacher Educators (AMTE) made a similar advocacy of the enhancement of the preparation of the teachers of mathematics in their technology position statement in which they advocated that all mathematics teachers training programmes should ensure that teachers have adequate facility to acquire the knowledge that would help them integrate technology use with teaching mathematics in the later period (AMTE, 2006). Yet the question of the efficacy of the given recommendations in improving the mathematics teachers' preparations remains under doubt (Niess, 2006).

The purpose of the AMTE Technology Committee is to advocate the examination, participation and assessment of the applications of technology to mathematics teacher education, and also to propose technology-related policy, related to mathematics teacher education programmes. The Committee started considering this issue, by commencing work on a number of mathematical-specific standards for TPACK (Niess et al., 2009). The AMTE Committee, according to their remit, weighed the detection of trends and criteria of the teaching of mathematics, required for the enhancement of mathematical education in the 21st century (Niess et al., 2009).

It will be necessary, in the future for teachers to possess the required ability and information to enable them to be efficient, assured and comfortable when utilising technological methods within the classroom (Banister & Vannatta Reinhart, 2011; Baran, Chuang, & Thompson, 2011; Mishra & Koehler, 2006). This is particularly the case because technological advancement and the current technologically-based civilization, modern ways of teaching and learning are being implemented in order to develop present-day education. Consequently, one of the goals of the King Abdullah bin Abdulaziz Education Development Project (Tatweer) is to supply a new curriculum for mathematics which is intended to incorporate modern technological progression. As a result, I think that this theory provides an opening for future educators to utilise technology as a means of education by advocating progression towards filling the technological divide and commencing the provision of a route across the broadening attainment breach.

The TPACK structure's priority is not so much what utilisation is made of technology but rather how technology is utilised in the field of education (Mishra & Koehler, 2006). It is necessary for teachers to be trained on the efficient utilisation of technology, particularly with regard to enhancing student progress and learning within schools (Graham, 2011; Polly et al., 2010). The intricate technological procedure is backed in the TPACK structure. Furthermore, technological methods, subject matter, appraisal and teaching methods, all centre on the strongest and most efficient criteria of successful technological incorporation (Pamuk, 2011). Therefore, this theory will help teachers not only to have an idea about technology in generally, but also will help them to know how to use technology to teach mathematics well.However, the TPCK model helped me think about content and the match between pedagogical content, but does not help me on teacher beliefs, concerns and motivations. This model will be great if the researcher only work with a school that already has technology and support by the head teacher. In short, the researcher needs to use both of these models, CBAM and TPCK, and also look at school problems.

The next four sections will provide historical roots of constructivist theory, radical constructivist theory, the role of social constructivism in mathematics education, and the role of constructivism and behaviourism in technology. And in the fifth and sixth chapters (5.7 and 6.2 sections) I will discuss how technology can support constructivist, and radical constructivist approaches when teaching and learning mathematics. Please see appendix 15 for more information on general overview of learning theories.

3.2 Constructivism

3.2.1 What is constructivism?

Constructivism is a learning theory that explains human learning as an active attempt to build knowledge through the learner using their own experiences and mental activity (Kanuka & Anderson, 1999). According to Davis, Maher & Noddings (1990), students are expected to formulate their own knowledge, both as individuals and by cooperating with others. As students attempt to solve problems that emerge in the environment, they are required to increase their knowledge with their toolkit of ideas and abilities. Other students and teachers constitute the community whose purpose is to supply the context, present the problems, and to provide the encouragement to motivate mathematical construction. Brooks & Brooks (1993), claim that constructivism is not a theory regarding teaching, but rather a theory concerned with knowledge and learning, which describes knowledge as transient, evolutionary, culturally and socially mediated and therefore non-objective. This approach is principally predicated on the idea that it is only through their current understanding that students are able to grasp new situations. Learning is a dynamic process where students, by connecting fresh ideas with their current knowledge, form meaning (Naylor & Keogh, 1999).

A common thread in all of these definitions is the student's active participation in problem-solving by using prior knowledge and experience. In other words, learners are the makers of meaning and knowledge. In contrast to behaviourism (please see appendix 15 for more details), constructivists argue that "*knowledge is not passively received but built up by the cognizing subject*" (Glasersfeld, 1995, p. 182). Constructivists focus on knowledge as a process, and behaviourists focus on knowledge as a product. Therefore, constructivists came to transform the focus from knowledge as a product to a process (Jones & Brader-Araje, 2002).

Constructivism as a theory has an interdisciplinary perspective; these other viewpoints include the personal constructivism of Piaget (1967) (please see appendix 16 for more details), the social constructivism of Vygtosky (1978) (please see appendix 17 for more details), and the radical constructivism of Glasersfeld (1995).

3.3 Radical constructivism

Glasersfeld (1995) defines radical constructivism thus:

> *An unconventional approach to the problem of knowledge and knowing. It starts from the assumption that knowledge, no matter how it is defined, is in the heads of persons, and that the thinking subject has no alternative but to construct what he or she knows on the basis of his or her own experience. What we make of experience constitutes the only world we consciously live in. It can be sorted into many kinds, such as things, self, others, and so on. But all kinds of experience are essentially subjective, and though I may find reasons to believe that my experience may not be unlike yours, I have no way of knowing that it is the same.* (p. 1)

Knowing beyond epistemology: The German-American philosopher Glasersfeld (1917-2010) was introduced to the epistemological model of radical constructivism in the 1970s. His principles are built on the ideas of Piaget, although he was deemed to be a considerably more radical than Piaget (Sinclair, 1987). Radical constructivism is an attempt to move beyond epistemology, according to Searle (1999), who stated that the preoccupation with epistemology has been the greatest exclusive barrier in the progression of a systematic theoretical method.

Radical constructivism is based on two principles: *"(1) Knowledge is not passively received but actively built up by the cognizing subject; (2) the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality*" (Glasersfeld, 1989, p. 114). Therefore, radical constructivism views knowledge as a construction. Glasersfeld (1990) suggests that knowledge is produced by the constructive activity of a person, rather than an article that exists outside the person, who holds knowledge, and can be channelled or implanted by means of a studious understanding or by communication through language.

Glasersfeld emphasizes the inaccessibility of reality, and proposes his view that the function of cognition is adaptive: Adaptation does not constitute an activity, but it can be described as being the consequence of the removal of everything that is not adapted. Therefore, in a biological context, all the things that survive are 'adapted' to the setting where they happen to exist. When this definition is removed from the biological context, and is applied to cognition, 'to know' will then not mean holding genuine representations of reality, but, instead, having the methods and techniques of behaving and thinking whereby the person will be enabled to achieve the objectives he or she happens to have decided (Glasersfeld, 2001).

3.4 The role of constructivism in mathematics education

Constructivism has undoubtedly been a major theoretical influence in mathematics education (Steffe & Gale, 1995; Glasersfeld, 1991), and has contributed to the support of reform efforts in this field (National Council of Teachers of Mathematics, 1989). This theory has provided a deep and thorough understanding of learning and learners for mathematics educators, which has enabled teachers to know how students think and learn in mathematics education (Simon, 1995). According to Mercer, Jordan, and Miller (1996), the teacher's knowledge of students has more influence over the success of the learner than the teacher's knowledge of problem solving strategies in maths. This is because the teacher's role in the maths class is not simply to solve or convey the information to students, but to provide cognitive restructure by negotiation of meanings of contextualised activities (Brooks & Brooks, 1993).

There are two types of constructivism: radical constructivism (sometimes know as individual or psychological) (Vygtosky, 1978) and social constructivism (Glasersfeld, 1995). Even within these categories, there are many positions (Steffe & Gale, 1995).

Radical constructivists and social constructivists assume that learners do not have direct access to reality but rather they have to construct their view based on their previous knowledge (Thompson, 2013).

The definition of constructivism presented by Glasersfeld (1989), is the best starting point when considering the role of constructivist theory in mathematics education, and consists of two hypotheses. The first is that knowledge is something that students should construct for themselves rather than receiving it passively. The second is that the process of adaptation requires constant adjustment through students' experience of the world; this is viewed as human construction.

Mathematics teachers have generally come to accept the first hypothesis, as they see it to be important, partially to ensure that their students are ready to construct new knowledge or concepts based on current knowledge (Lerman, 1989). According to Cobb (1988), mathematics educators should not transfer information into pupils' heads, but those students should construct their own understanding themselves. According to Ellerton & Clements (1992), knowledge of mathematics is what students create themselves by actively searching and forming mental links, rather than something received as a result of studying textbooks or following the words of teachers. When people make active connections between dimensions of their social and physical environments and a number of numerical, spatial and logical concepts, they often acquire an understanding of ‘ownership’. Thus, the role of mathematics educators in this position is to facilitate cognitive restructuring and conceptual reorganization. In addition, as Berieter (1985) noted, a basic principle in current perspectives of learning is that knowledge and cognitive approaches are vigorously created by the student. This widely-held assumption will lead to students' cognitive development when their previous knowledge is revised to make it compatible with new information (Cobb, 1988).

The second hypothesis is a stumbling block for many mathematics educators. This segregates what von Glasersfield refers to as trivial constructivism, what Cobb refers to as empiricist-oriented, and what Davis and Madon (1986) refer to as simple constructivism deriving from the radical constructivism founded on the acceptance of the two principles (Kilpatrick, 1987). Jaworski (1993) claims that the strength of constructivism regarding mathematical education is summarised in the second principle.

When this is briefly applied to learning mathematics, it appears to suggest that that should there be any independent, original core of mathematical knowledge, it can be known only through our own experience, and all that we can know is what we ourselves have built and altered in line with additional experience.

Once we know the role of constructivism in mathematics education, it is important to understand how mathematical knowledge is constructed and reconstructed, and this is a central concern of mathematics educators. According to Sierpinska & Lerman (1996), mathematics educators should be concerned with a rational rebuilding of thought processes of scientists, not only in the process of discovery, but also in scientists' attempts to communicate and vindicate their discoveries. However, this seems controversial because previous research suggests that students construct their own mathematical knowledge independent of the way they are taught (Murray, Olivier, & Human, 1993). This means that however pupils are taught they always understand from their own perspective. This is apparent when we see that two students in the same classroom, of the same age and at the same time have different levels of understanding and provide different responses to instructional practices; this is because students come to formal education with different previous understanding that significantly influences the way they construct new mathematical knowledge (Ndlovu, 2013). This, in turn, affects their newly-acquired knowledge in mathematics. In other words, the conventional patterns of regarding teaching as a conveyance and learning as assimilation of facts are demonstrated as being untrue, because if direct mapping from teacher to student existed, then each student would acquire an exact copy of the knowledge, abilities and store of knowledge (Ndlovu, 2013). Thus we can see that there are, in fact, individual differences in learning between students.

To encourage students to construct their own knowledge, we will turn to Piaget's theory of cognitive development; he believed that there are two basic ways that pupils can adapt to new knowledge, experience and information. The first is assimilation; through this process we tend to modify knowledge or information somewhat to fit into previous schemes. The second is accommodation; through this process we change or alter our existing internal schemes as a result of new information. All this is called the process of knowledge transformation (Piaget, 1953). As a result, according to the constructivist perspective, teachers do not teach students about mathematics but instead teach them how to develop their cognition (Confrey, 1990). In other words, teachers must help students to construct new knowledge and experiences from their prior experiences by the processes of accommodation and assimilation to restore equilibrium in the students' understanding. Constructivist theory shows us how to do this effectively, according to the constructivist argument that: It is necessary that the mission of the teacher is focused on deducing models of the conceptual constructs (or networks) of the learners. Teachers, accordingly, must then put up hypotheses on the way in which to offer the learners the opportunity to amend (reconstruct) their conceptual structures or schemas. Thus, learning is filtered into a human activity that is led and pushed forward by a process of self-supporting, self-reflexive cognitive actions of equilibration and re-equilibration whereby transition from one grade of understanding to a higher one is caused (Ndlovu, 2013).

A number of researchers have criticised radical constructivism, because this approach ignores the social aspect of learning (Ernest, 1993a; Goldin 1991; Lerman, 1992). It is important to look at the role of social constructivism in mathematics education, since social constructivism is the primary side of interactions between students and teaching (Ernest, 1993b). If mathematics teachers link this theory to mathematics education, they will be able to understand the nature of mathematical knowledge as a social construct, as well as being able to reconcile the students' own knowledge with the sociological aspects of the learning and teaching of mathematics (Ernest, 1994). Ernest (1991) focused on the nature of mathematical knowledge as a social construct because the nature of mathematics deeply influences its teaching and learning. This effect leads us to understand how we can determine the nature of mathematics. According to Raghavan (1994), the history of mathematics is the only thing which is essential to determining the nature of mathematics, since it forms part of its philosophy; it is especially important in order to explain the source of knowledge or the nature of truth. Philosophical schools of mathematics, such as formalism, logicism and intuitionism, have attempted to provide logical proofs for basic mathematical concepts (Wilder, 1972; Heyting, 1983; Luchins & Luchins, 1965). In other words, their main concern has been to justify the knowledge, and to understand the nature of knowledge.

Overall, "*the issue, then, is not, What is the best way to teach? but, What is mathematics really all about?…Controversies about…teaching cannot be resolved without confronting problems about the nature of mathematics*" (Hersh, 1979, p.34). The teacher should understand the nature of learning, and how it occurs, to meet the learning needs of learners. This is apparent when we view the shift in theorists from behaviourism towards a more constructivist approach to allow students to develop their cognitive thinking abilities and to be able to relate.

Constructivist theory does not only focus on individual constructivism depending on Piaget's theory already described, but also takes the meaning of construction as a social activity, proposed by Vygotsky's theory to develop peer collaboration. In other words, constructivism does not just focus on the individual aspects of learning, but it includes other aspects such as the social aspect as a part of the individual.

3.5 The role of constructivism and behaviourism in technology

As mentioned earlier, in 1960, two learning theories emerged to influence the later development of technology in the classroom; these theories are behaviourism theory (please see appendix 15 for more details) and constructivism (McClintock, 1992). As we know, the main purpose of behaviourism is to promote desired behaviours within individuals (Parkay & Hass, 2000). Thus, the incorporation of new technologies, such as interactive web-based programs, will impact on students' academic behaviour (Pitler, Hubbell, Kuhn & Malenoski, 2007). However, of late, the constructivist theory has come to the forefront. Many researchers (e.g., Black & McClintock, 1995; Richards, 1998; Brush & Saye, 2000) have studied the effect of constructivism on classroom practice. Other researchers have suggested that technology can assist in implementing constructivist strategies (e.g., Duffy & Cunningham, 1996). As a result, there is a relationship between computer technologies and constructivism, through which the teacher can encourage collaborative learning and higher-level thinking, i.e. through the use of technology (Judson, 2006). According to Duffy and Cunningham (1996), who clarified the role of technology in learning through constructivist theory: Technology is regarded as an indivisible section of the cognitive activity. The distributed cognition perception has a considerable impact on the way we view the part played by technology in the field of education and training. This is centred on the activity within the environment, rather than on separate individuals and what they know. The contextualised and focused activity is the pivotal factor. The purpose of the construction process is to lead to a world that is understandable to us and is appropriate for the daily activity of our lives.

In addition, Morrison, Lowther, and DeMeulle (1999) state: There is no need for technology and constructivism to be in conflict. When we perceive computers as problem-solving tools, rather than simply a method to input a command, these reforms can have an impact on the utilisation of technology, which, in turn, can have an impact of educational reform. It is important for mathematics teachers to know how constructivist thought can be applied to the integration of technology in the classroom. There are many types of educational technology that can be paired with constructivist concepts to create a classroom that is learner-centred, where students can thrive in a learning environment. Constructivism and technology can work together to create new experiences in order to help students progress. However, technology should not be considered as merely an adjunct to teaching, and even exemplary teachers need to view it as integral to the process of learning (Pierson, 2001).

3.6 Defining mathematical learning difficulties

Many researchers have used a variety of definitions and terms to describe pupils who experience difficulty with mathematics, for example, dyscalculia, mathematical disabilities, mathematical learning disabilities and mathematical learning difficulties (Mazzocco, 2007). Dyscalculia, mathematical disabilities and mathematical learning disabilities are usually reserved for those students who have a particular disability and are in need of special education services (Westenskow, 2012). There are many different kinds of such learning disabilities in mathematics, and these can affect many different mathematical topics (Gersten, Clarke, & Mazzocco, 2007). Researchers have found that approximately 6% of all students have some form of mathematical disability (Dowker, 2005; Gersten, Jordan, & Flojo, 2005).

On the other hand, the term 'mathematical learning difficulties' includes those students who experience learning difficulties in the context of the school classroom environment, and their difficulties may be specific to one or two topics. In other words, this term involves a disorder resulting from environmental influences rather than a disorder that is inherent in students (Westenskow, 2012). The term mathematical learning difficulties is usually used with those students who have mathematical achievement test scores of less than the 35th percentile (Gersten et al., 2005). Generally, mathematical difficulties refers to those students who fail to reach the level (the level reflects the measurement of progress in the current educational system in Britain) commensurate with their age, such as Level 1 at age 7 or Level 3 at age 11, as a great deal more effort is required of them to perform successfully; for some students, mathematics does not come automatically, and they may need more time and energy on the part of the teacher to pass through their difficult stage in mathematics (Dowker, 2004). This research focuses on this type of learning difficulty in mathematics within primary education, and below, the reader is given an overview of mathematics learning difficulties in primary education.

Many researchers have studied the spread of learning difficulties in mathematics, which is estimated to be 5 to 8% of all students (Desoete, 2007; Geary, 2004; Stock, Desoete, & Roeyers, 2006). For example, Bzufka, Hein, and Neumarker (2000) invited 363 students from the German Third Grade, of whom 181 were urban and 182 rural. The researchers gave them standardized school achievement tests to examine the extent of their abilities in arithmetic and spelling. They found that 12 pupils from both the urban and rural groups achieved above 50% in spelling; however, they scored less than 25% in mathematics. In addition, Lewis, Hitch, and Walker (1994) used three types of test, including Raven's Matrices IQ test, Young's Group Mathematics Test, and Young's Spelling and Reading Test, in order to determine student difficulties in mathematics. The sample incorporated 1,056 pupils aged 9–10. The researchers found that 1.3% of those students had problems with arithmetic, and that 2.3% had difficulties in both reading and arithmetic. As a result, they concluded that 3.6% of this sample had difficulties in arithmetic. The main conclusion to be drawn from these studies is that some students have difficulties with mathematics, and that these difficulties differ from one student to another, which often depends on the methods and criteria used in their studies.

According to Carnine, Jitendra, and Silbert (1997), students with learning difficulties should not be classified as being intellectually impaired; rather, their difficulties may result of the inadequate design of instruction materials or from pedagogic failings. This is not surprising, as poor instruction is a primary cause of mathematics difficulties. Onyeachu (2008) emphasised that instructional materials are merely designed to serve as a tool to assist pupils in their learning, through simplifying the learning tasks and making learning effective and understandable. In addition, constructivist theory plays a role in this context (Carnine et al., 1997; Jitendra et al., 2005; Sood & Jitendra, 2007). According to Richardson and Placier (2001), constructivist theory provides a useful basis on which to design the curriculum; indeed, educators should build the curriculum based on the principles of the constructivist learning theory, as mathematics is viewed as a human activity (Streefland, 1991).

Many researchers use the words ‘error’ and ‘misconception’; it is an important to clarify the differences between these and ‘mathematics difficulties’, and to give the reader a complete and transparent picture of what is meant by mathematics difficulties.

There are differences between errors and misconceptions. According to Riccomini (2005), an error can be defined as a wrong answer to a question (possibly unintended) that is non-recurring, and that the student can easily modify. Errors in mathematics are classified in five types. The first relates to language difficulties; mathematical can sound like a foreign language to students, and this problem usually arises when they learn of new mathematical concepts or formal vocabulary. As a result, if students do not understand the semantics of the mathematics language very well, they will make errors from the beginning of a problem-solving exercise. The second is when students are unable to process the mathematical knowledge in a particular solution to a problem. The third is when students are unable to recall the requisite information in solving a task. The fourth relates to transfer errors caused by decoding and encoding information. Finally, errors appear when students use irrelevant strategies or rules to solve a problem in mathematics. Moreover, Orton (1983) classified errors into three categories, as follows: (1) Structural error: this is an error that arises from some failure to appreciate the relationships involved in the problem or to grasp some principle essential to its solution. (2) Arbitrary error: this is an error in which the subject behaves arbitrarily and fails to take into account the constraints laid down in what was given. (3) Executive error: this is an error where the student fails to carry out manipulations, even though the principles involved may have been understood. However, according to Li (2006), student errors in mathematics are the symptoms of misconception. Thus, what is the definition of misconception in mathematics?

The concept of misconception in mathematics differs from that of error. Research has shown that student misconceptions contribute to the process of learning mathematics, and thus misconceptions grow from concepts and beliefs that have already been gained but wrongly applied to an extended domain (Posamentier, 1998). Therefore, the expression ‘misconception’ within fundamental mathematics normally occurs before instruction, particularly when students standardise knowledge already obtained with new knowledge erroneously (Nesher, 1987; Resnick et al., 1989). I can conclude from the concepts of error and misconception that the teacher can see the errors that the students make in tasks, but misconceptions are often hidden from the undiscerning observer. Furthermore, the teacher cannot see misconceptions in correct answers (Smith, di Sessa, & Roschelle, 1993).

In the next section, misconceptions and difficulties in mathematics education are discussed further; it will clarify the point that misconceptions in understanding mathematical concepts can lead to permanent difficulties in those students who have problems in mathematics.

3.6.1 Misconceptions and difficulties in mathematics

Knowledge of the common difficulties and misconceptions that students have in mathematics can provide a clear explanation for teachers as to how children think; such knowledge can provide teachers with a basis for making instructional decisions in teaching and learning (Black & Wiliam, 1998; Schmidt et al., 1996; Stigler & Hiebert, 1999; Williams & Ryan, 2000). The social constructivist view suggests that it is time to consider the errors that students make in classrooms through persuasion, discussion and even by replacing or radically reorganizing student knowledge, so that the student is the one to restore or organise their own conception (Cobb, Yackel, & McClain, 2000; Ryan & Williams, 2000).

3.6.1.1 Common misconceptions and difficulties

Area	Difficulties	Types of misconception
Subtraction	- Thinking that subtraction is commutative, for example 10 – 4 = 4 – 10.	- Over generalization from addition. - Not understanding place value.
	- Borrowing from zero in subtraction calculations.	- Faulty procedure.
Multiplication	- Failing to understand that any number multiplied by zero equals zero.	- Trouble correctly understanding the role of zero in multiplication. - Incomplete knowledge. - Over generalization from addition.
	- Multiplication always makes	- Over generalization.

	bigger.	
	- Transition from additive to multiplicative thinking.	- Over generalization from addition.
Mathematical equivalence	- Understanding of the equals sign. For instance, given a problem such as 2 + 6 + 9 = 2 + _, it is evident that large numbers of students are unable to answer equations that entail operations on either side of the equals sign.	- Students are not ready to learn the relational concept. - Lack of domain general logical structures. - Immature working memory system.
Fractions	- Failure to recognise fractions as numbers.	- Over generalization of whole-number knowledge.
	- Believe all fractions are halves.	- Conceptual understanding.
	- Equivalent fractions.	- Incomplete knowledge.
	- Procedures for solving fraction problems.	- Faulty procedure. - Memory problem. - Incomplete understanding of the language of math. -Visual spatial or ordering difficulties. - Attention difficulties.
	-Multiplying and dividing fractions	- Over generalization from whole numbers.
Division	- Description (when teacher asking students to explain why and how they answered the way they did, many pupils being unable to describe why they have reached the conclusion they have reached, even when they are clearly able to understand the task itself).	- Incomplete knowledge.
Place value	- Place value concepts.	- Procedure.
	- Multi-digit number sense.	- Incomplete knowledge. - Conceptual understanding.

Table (3.2): summary of common misconceptions and difficulties

Firstly, there are difficulties and misunderstandings relating to arithmetic operations. Resnick (1982), in outlining the most frequent errors made by students, began with subtraction. The two errors that appear most often are Smaller-from-Larger mistakes or errors in borrowing. The Smaller-from-Larger error occurs when a student subtracts the smaller digit from the larger digit regardless of where each digit is placed. This is shown in the example below (Sadi, 2007).

$$
\begin{array}{r}
543 \\
-\ 237 \\
\hline
=\ 314
\end{array}
$$

It is evident that in this example the student has subtracted the 3 from the 7, as 3 is a smaller number than 7. This is based on the assumption that subtraction is commutative; therefore, making it clear to students that subtraction is non-commutative should diminish the frequency of Smaller-from-Larger errors. From a young age, students must be taught that the order of the digits is extremely significant in subtraction (Sadi, 2007). Another misconception (and ensuing difficulties) associated with arithmetic operations is when students encounter zero. Possibly the greatest difficulty students have involves borrowing from zero in subtraction calculations (Sadi, 2007).

The second misconception and associated difficulties that students have is about multiplication. This appears when elementary students deal with zero in multiplication and division operations. Failing to understand that any number multiplied by zero equals zero is one of the most prevalent multiplication errors (Sadi, 2007). For example, in a study by Rees and Barr (1984), it was found that, in a public examination, 52% of a sample of 8,613 people wrote the following: $9 \times 0 \times 8 = 72$. It is most likely that this mistake is made because students have trouble correctly understanding the role of zero in multiplication – many people interpret zero as standing for nothing. Consequently, they assume that multiplying a number by zero does not change the number (Sadi, 2007).

Similarly, the decision whether to include or omit zero commonly confuses students. It is likely that this is associated with the fact that they are often taught that adding zero to a decimal does not alter the number and is thus superfluous; for example, 45.80 has the same value as 45.8 (Sadi, 2007). The decimal system has proven to be more problematic for students compared with other (similar) numerical systems. A disparity arises between the students' recognition of the original numerical system and the introduction of the decimal system.

Another misconception with multiplication for students in primary schools is about their thinking on multiplication. The problem arises because the student may think that multiplication must make numbers larger and division must make them smaller. In this case, teachers have to develop multiple strategies to help those students who have this problem; in particular, they must enable them to develop number sense that extends beyond whole numbers. According to Bell, Swan and Taylor (1981), children's knowledge of multiplication and division includes the belief that “multiplication always makes bigger” and “division always makes smaller”. This is observed when pupils work on two aspects, the first involves purely numerical items and the second involves story problems. As a result, this misconception can lead to obstacles for students when they move from the field of integers to the field of rational numbers (Prediger, 2008). Some researchers have found that many processes can be obtained from multiplication, and that conceptual understandings can then be obtained from it (e.g., Harel & Confrey, 1994; Hiebert & Behr, 1988; Sowder et al., 1998). Therefore, multiplication is the most important operation to understand in mathematics (Ell, Irwin, & McNaughton, 2004), and this requires learners to develop their thinking in numbers and operations (Davydov, 1992; Jacob & Willis, 2001; Schwarz, 1988).

Another important question relates to how children think about multiplication. This question is important because, according to Nunes and Bryant (1996), in children’s way of thinking, multiplication and division constitute an important qualitative change. In addition, some researchers have found that multiplication is more difficult than addition and subtraction operations in elementary schools (Davydov, 1991; Greer, 1992). To answer the above question, usually the way children think about multiplication comes from the way they answer problem situations. According to Nesher (1998), the strategies that students use to solve mathematical problems are taken into account as an indication of how those students think on order to solve these problems in multiplication.

Moving from the misconceptions that students have in multiplication to the difficulties that they have in this aspect, one of the major barriers to learning mathematics in primary schools occurs when students are in transition from additive to multiplicative thinking. Teachers must help their students through the use of meaningful mental objects to enable them to understand the relationship between addition and multiplication in order to progress to further study. According to Clark and Kamii (1996), the transition from additive to multiplicative tasks seems to be a major hurdle for students in primary schools. Understanding the fundamental concepts in mathematics is like building blocks; if students in schools fail to understand addition properly before moving to something new, such as multiplication, they will get lost

(Fleming, 2014). Please see appendix 18 for another misconceptions among students in primary schools.

Finally, an important question arises now that we have understood some of the misconceptions and difficulties that students face when learning mathematics: why do students experience difficulties in mathematics education?

3.6.2 Development and persistence of mathematics anxiety

Under-achievement in mathematics can cause students to develop mathematics anxiety. This is defined as the experience of tension or anxiety which hinders the process of solving mathematical problems in both academic and social contexts (Das & Das, 2013). It involves a low level of confidence (Jain & Dowson, 2009), a sense of being threatened (Zohar, 1998), the feeling that one is failing to achieve one's potential (Perry, 2004), and a short-term impairment of working memory (Ashcraft & Kirk, 2001). Mathematics anxiety has also been described as a feeling of 'sudden death' (Tobias, 1993). Considering these definitions, it seems that mathematics anxiety contributes to difficulties in manipulating numbers and solving mathematical problems in academic and social situations (Richardson & Suinn, 1972; Suinn, Taylor, & Edwards, 1988). Therefore, as a psychological construct, mathematics anxiety is clearly a significant cause of poor performance in mathematics (Das & Das, 2013).

Newstead (1995) highlights that there is a lack of consensus regarding the origins of mathematics anxiety among children. He considers possible causes including the teacher's anxiety, features of the social or educational environment, the inherent nature of mathematics, a history of poor performance, and the effects of pre-school experiences of mathematics. Tobias (1978) and Stodolsky (1985) demonstrate that it is well documented that the anxiety frequently originates from negative experiences in the classroom.

The failure of parents, teachers, learners, schools and policy makers to take adequate account of the influence of mathematics anxiety could have a disastrous impact on the education system (Das & Das, 2013). For example, mathematics avoidance is a common result of mathematics anxiety (Hembree, 1990), as are distress (Tobias, 1978) and impairment of conceptual thinking and memory processes (Skepm, 1986). These results of mathematics anxiety are connected to cognitive operations which depend upon working memory resources (Ashcraft, 2002).

3.6.3 Cultural influence on mathematics

It has been established that culture represents a factor that has a powerful impact in mathematics learning and teaching (Wang & Wu, 2010). Barrett (1984) defines culture as "*the body of learned beliefs, traditions, and guides for behavior that are shared among members of any human society*" (p.54). Likewise, as suggested by Erickson (1986), as a social scientific term, culture is related to learnt and common benchmarks of how to think, feel and behave. In understanding the role of culture in mathematics education, defining what culture means in mathematics education is vital. In the view of Leung, Graf, and Lopez-Real (2006), "*Culture refers essentially to values and beliefs, especially those values and beliefs which are related to education, mathematics or mathematics education*" (P.4). For example, in the study by Bryan, Wang, Perry, Wong, and Cai (2007), who combined the results of the (Perry, 2007; Wang & Cai, 2007a, b; Wong, 2007), they introduced the perceptions of educators - from Australia, Mainland China, Hong Kong SAR, and the US - of mathematics and its teaching and learning. A cross-cultural comparison was conducted by Bryan et al. between the results related to each of the four regions studied.

One of the findings was that the views of some of those educators about the nature of mathematics and its learning and teaching displayed an East-v-West cultural dichotomy, while some others expressed views which were much more of an East/West cultural continuum. For instance, the educators from Mainland China and Hong Kong SAR perceive the nature of mathematics from a ''Platonic view'', which means that they concentrate on the inner, rational structure of mathematics, which shows it as an abstract form of knowledge. On the other hand, the educators from Australia and the US focus on the ''functional view'' of mathematics, which means that mathematics, for them, is a helpful instrument employed on a daily basis resolve real-world problems. The educators from Australia and the US put more focus on mathematics as a language through which to define and explicate a physical phenomenon. The issue of the qualities of a successful educator has also articulated the differences in mathematics education between both the Eastern and Western cultures. With regard to the teacher's enthusiasm and affinity with students, the educators from Australia and the US expressed more views that the educators from Mainland China and Hong Kong did. The educators from Mainland China and Hong Kong concentrated on how well teachers plan and deliver a lesson and their capacity to offer well-defined explications of the points to be discussed during the lesson. The comments on the qualities of a successful teacher were echoed in the comments on what makes a successful lesson, although from a different standpoint. While the educators from the Eastern regions (Mainland China and Hong Kong) tended to stress the ‘‘teacher-led’’ aspect of mathematics teaching in the classroom, the educators from the Western regions (Australia and the US) underlined the ‘‘student-centered’’ aspect.

3.7 The Role of technology in teaching and learning mathematics

3.7.1 Introduction

Technology is an increasingly important aspect of modern education, and its relevance is spreading to virtually every field (Glaubke, 2007; McCarrick & Li, 2007), and therefore technology has become an integral part of our daily life. Students want to bring what they are doing outside school into classroom, such as computer games, smart phones, social networking and MP3 players (Gutnik, Robb, Takeuchi, & Kotler, 2011; Rideout, 2011). According to Natalie (2011), as cited in FoxNews, 2011, "*we know that students live in technology outside the classroom. And we know that if we can spark interest in a subject through technology, students will be more willing to stretch their brains and try new things*" (p. 1).

With respect to beliefs, mathematics, to most students, is a complex and difficult subject, involving language, space and quantity (Sarma & Ahmed, 2013). Moreover, mathematics is possibly the only subject that involves an educator-pupil misunderstanding. When the teacher is in front of the blackboard, the meaning of symbols and their relevant possible conclusions are absolutely obvious to him/her, but this could be completely the opposite to many pupils (Sarma & Ahmed, 2013). However, when integrated with teaching techniques, technology can promote the translation of mathematical concepts from one mode into another, thereby making ideas more tangible (Suh, Moyer, & Heo, 2005). More researchers undertook additional examination of how incorporation of IWB in the teaching methods is able to improve the students' understanding of mathematical thought (Taylor, Harlow, & Forret, 2010), as well as motivation (Beauchamp & Parkinson, 2005; Hall & Higgins, 2005; Schmid, 2008) and also performances (Lopez, 2010).

Moreover, technology may enable students to access quality education, and to obtain the skills and knowledge they will need for solving problems (Meyen, Poggio, Seok, & Smith, 2006). In addition, “technology in Education” (2011) declared that occasionally reserved or introverted students who have a tendency to avoid involvement in the usual classroom enterprises will be likely to participate in the utilisation of technology because they perceive it to be less threatening. Moreover, technology allows students to touch and see information, which facilitates comprehension through summarizing, thereby increasing learning capacity (Merrill, 2007). It is broadly accepted that this technology will revolutionise methods of learning and teaching, enabling them to become more relevant, appealing and more meaningful to the each of the students, consequently profoundly transforming the standard of students’ understanding in the field of learning (Karasavvidis & Kollias, 2014).

In order to understand the effect of technology on mathematics learning, we need to review the historical relationship between technology and mathematics education.

3.7.2 The history of using technology in mathematics education

The table (3.3) below shows a summary of the history of using technology in mathematics education (see appendix 19 for more information).

Years	The type of technology
In the early part of the 20th Century	Public schools used audio-visual aids such as charts, lantern slides and pictures to help students visualize object or problems (Reiser & Dempsey, 2007).
In 1913	Thomas Edison announced, “Books will soon be obsolete in the schools. Scholars will soon be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture. Our school system will be completely changed in ten years” (cited Saettler, 1990, p. 98).
During the 1920s and 1930s	Radio was a medium that attracted considerable attention in the 1920s and 1930s (Reiser & Dempsey, 2007).

During the 1950s, 1960s and 1970s	Television was the focus of attention. As we know, after the use of television in education, many technologies that have a positive impact in the teaching of mathematics have appeared. However, I will focus on the role of computer use in the teaching of mathematics, because Saudi teachers use the computer frequently, and for multiple purposes.
The late 1970s to the early 1990s	This was at the time when the application of computers in education was in its early stages.
In 1990	There is another type of technology which is called interactive whiteboards (IWB), and the first interactive whiteboards for use in the office were designed in 1990 by Xerox Parc (Greiffenhagen, 2000).

Table (3.3): Summary of the history of using technology in mathematics education

The table (3.4) below shows a summary of The effect of TV, computer and IWB on teaching and learning (see appendix 19 for more information).

The type of technology	**Its effect on students learning**	
Television	1- A study was conducted on the impact of combining multiple systems and presenting them simultaneously, in which the researcher posited two main hypotheses; the first is that when TV-based information uses only audio and visual information, this may reduce the students' understanding, leading to not retaining information in the immediate memory. The second hypothesis is that when TV-based information uses multiple formats, such as visual images, sounds, spoken and written language, this may help pupils to remember and understand to a greater extent (Kozma, 1991). 2- Television exerts a powerful influence on cognitive skills, imagination and the task perseverance of children (Gladkova, 2013).	
Computers	Microsoft PowerPoint (advantages)	1- Mayer and Anderson (1991) conducted a study to compare teachers who presented information at school with words and pictures together, with other teachers who used words in preference to pictures. The researchers found that the teachers who presented information with words and pictures were more effective than those other teachers; the main reason

		being that the human brain processes information better when it is accompanied by images. 2- Similarly, Peek (1987) focused on the effect of a PowerPoint presentation on the ability to retain information for the future. He found that it is easy to retain information relating to familiar concepts, but that it is difficult to retrieve information relating to unfamiliar or unclear concepts. As a result, he found that pictures and words together tend to improve memory retention in pupils.
	(Disadvantages)	Many researchers have found that multimedia presentations do not show an increase in student performance in schools (e.g., Stoloff, 1995; Susskind, 2005; Szaba & Hastings, 2000). This is due to the fact that some teachers use PowerPoint in a way that inhibits interaction between the presenter and audience (Driessnack, 2005); moreover, some teachers limit the level of detail, making reading the slide a challenging activity (Driessnack, 2005). This latter leads to reducing the analytical quality of presentations (Stein, 2006).
IWBs	The role of IWBs is to support recall; students can remember what they have learned in a class because, as we know, multi-sensory input makes learning more memorable. According to Burden (2002), “when I talk to the children about what helps them remember, they say they can still see the images in their mind, even after we have finished a lesson” (p. 17). In addition, the teacher can exploit the IWB’s versatility to move images or to zoom in when presenting the lesson, and can use a wide range of colours, all of which enhance the learning process (Damcott, Landato, Marsh, & Rainey, 2000; Bell, 2002; Levy, 2002; Thomas, 2003).	

Table (3.4): The effect of TV, computer and IWB on teaching and learning

The question that now arises is: how can we exploit the established role of technology in mathematics education to address difficulties in mathematics, and how should we use it to its best advantage? Therefore, the task ahead is to better comprehend the role of technology in assisting those students who have difficulties in mathematics.

3.7.3 The role of technology in mathematics education is to increase motivation and the capacity to solve mathematical problems on the part of pupils who have arithmetical difficulties.

Many researchers agree that IWB has a positive effect on student motivation (eg. Hall & Higgins, 2005; Higgins, Beauchamp, & Miller, 2007; Shenton & Pagett, 2007; Smith, Hardman, & Higgins, 2006; Smith et al., 2005; Thompson &Flecknoe, 2003). Wood and Ashfield (2008) discovered that the large screen and the multimedia capacity of the interactive whiteboard provided a means of enjoyment which subsequently improved student motivation. It is claimed by Levy (2002) that students are motivated by IWBs to respond to questions asked by teachers as a result of the powerful visual and conceptual appeal of the depicted information and also because they enable students to apply a physical interaction with the board as they seek the answers. In the next part, the literature will show evidence from some studies that technology can increase the motivation of the students who have mathematics difficulties.

Torff and Tirotta (2010) conducted research work to establish to what degree the utilisation of interactive whiteboard technology (IWB) contributed to the level of motivation in mathematics reported by upper elementary students. A total of 773 students (241 4th grade, 260 5th grade, and 232 6th grade) took part in the research study. The number of teachers who participated was 32, and 19 of them stated that they used IWB (the treatment group), and 13 of them noted that they did not widely use IWB (the control group). There were 458 students in the treatment group and 315 in the control group. According to the findings of the research study, a higher level of motivation was displayed by the treatment group students, compared with the control group students. Also, students whose teachers are supportive of the utilisation of IWB technology showed a higher level of motivation, in contrast to students whose teachers are less keen on the use of IWB. The present study differs from this study, because it is evident that the above study was implemented in non-Arab countries and the sample was large compared to the current study.

Taylor (2009) centred their research work on how teachers can increase student motivation by integrating interactive whiteboard into classroom teaching. The study made use of three third-grade classrooms, which have varying utilisations of IWB. The analysis included details on multiplication fluency, the capacity to depict the mathematical concepts of multiplication, the opinions of students as indicated in the survey responses, together with end of unit assessment scores. There was an increase in student motivation relating to the use of interactive whiteboard in a very interactive student-directed method. Classroom students who used this interactive technology achieved a higher academic standard, and revealed more good opinions of the interactive whiteboard and mathematics. The present study differs from this study, because it is evident that the above study adopts a survey and the current study applied semi-structured interviews and observations.

3.7.4 The role of technology is to save teaching time and to discourage and minimize adverse outcomes for those students with difficulties in mathematics, especially in early intervention.

Starting with Bidaki and Mobasheri (2013), their study found that one of the benefits of technology is saving teaching time. They conducted a study entitled "Teachers' Views of the Effects of the Interactive White Board (IWB) on Teaching" which was implemented in a council primary school in Aberdeen, UK. A total of 198 pupils in 7 classrooms from P1 to P7 participated. The information was collected from one interview with the head teacher and four interviews and five questionnaires with teachers. Usage of interactive whiteboards (IWB) and how this impacts on whole-class teaching was one issue considered in the study. The attitudes of teachers formed the foundation of the study. The collected information was from interviews and questionnaires. It was revealed that IWB has been a greater impact on teaching than was anticipated. The study implied that IWB is able to improve pedagogical skills, enhance the attention of the students thus saving teaching time. Additionally, this technology may help to reduce the function of classroom teachers and develop an improvement in student skills, for example team work and discussion. It is evident that the above study adopts questionnaires and interviews, and that this study applied semi-structured interviews and observations. Additionally, the above study was implemented in non-Arab countries and this is where it differs from the present study.

Moving to other studies which emphasised the importance of early intervention through technology for those students who have mathematics difficulties. Researchers hope that early interventions could help students with numeracy-related problems, through decreasing or preventing these difficulties that may occur at a later stage (eg. Clements & Sarama, 2011; Ramey & Ramey, 1998). A report by Prince Edward Island (2011), entitled Early Numeracy Intervention Program, showed that the most important approach to take with students who have mathematics difficulties, especially those aged

6- 8, is early intervention, through the First Steps in Mathematics (FSiM) program. Two main reasons for considering an early intervention program were presented. Firstly, children who have this condition are addressed during these crucial early years, and then have more opportunities to fully develop their abilities. Secondly, early intervention programs minimize and discourage adverse outcomes for children.

The FSiM program is designed to help pupils in grades 1, 2 and 3, laying the groundwork for lifelong education. Three trained consultants worked for 25 days with those pupils. After the pupils had completed the Early Numeracy Intervention Program, the researchers handed out the evaluation questionnaire to gain information from teachers, administrators and parents about the effect of the program (PEI, 2011). The results show that the pupils became more confident in understanding numbers, learning how to manipulate numbers, and learning the basic facts of maths. Some parents said:

> *I think it has made maths easier to understand and therefore makes the school experience better.*
>
> *She has discovered that maths isn't scary or boring but it can be fun and that she can do it.*
>
> *He has been very positive about school and this program has really helped improve his confidence and he has shown much progress.*

Some teachers said:

> *I find my students are more confident when it comes to maths, no longer do they look down to avoid having to answer a question.*

Some administrators said:

> *ENIP has had a very positive impact on students, evident in an increased interest, self confidence and enjoyment in numeracy learning.*
>
> *We feel that ENIP has given these children in the program another opportunity to establish a solid foundation with the primary outcomes.*

A number of other studies have also identified that Computer Assisted Intervention (CAI) is a useful tool for arithmetic support (Butterworth & Laurillard, 2010; Räsänen, Salminen, Wilson, Aunio, & Dehaene, 2009; Wilson et al., 2006). For instance, Wilson et al. (2006) focused on how technology can help students with mathematics difficulties. They used The Number Race software, which is designed for children aged 5–8, to teach and train them through entertaining numerical comparisons. Researchers designed this software to provide intensive training. The game uses an algorithm, whose task is to establish the knowledge space of each child. The Number Race software experiment was carried out on nine children, during five weeks, using direct observation. They had to play a comparison game, in which there are two main screens. Each screen has a task, such as 4 + 5 = 9 and 3 + 3 = 6, although the quantity can be represented in a non-symbolic format, a symbolic Arabic format or a symbolic verbal format. In this situation, the student must carry out a numerical comparison task, choose the larger quantity, pick the screen with the larger quantity, and finish the game within a specific time limit. When the student completes the task in hand, the next task will be more difficult than the previous one. The computer will give the student who successfully completes the task golden tokens, which will help the student progress through the squares on the game board. The player can compete against the computer to make the task more challenging and fun. In higher levels, the student must add or subtract in order to make a comparison, and at the end, the children collect their reward and can start a new phase of play with a new character. The designers used a multidimensional learning algorithm to adapt the difficulty of the program, simulating the children's learning and helping them to learn using three dimensions of difficulty (distance, speed and conceptual complexity). These dimensions constitute the learning space, where children can be presented with a problem at any point in this space. After analysing the children's data through Matlab programs, they found that the software was successful and delivered the expected results, in addition, the researchers received a positive feedback from the students, parents and teachers.

3.7.5 The role of technology in mathematics education is to give meanings to numbers, to boost students' confidence and to help students to remember what they have learned.

A study was conducted by Alabdulaziz (2013), the purpose of which was to investigate the effect of technology on the mathematics learning of Saudi primary students with mathematics difficulties, and to investigate the teachers' usage of technology with those students, and their perceptions about using this technology in Saudi Arabia. Overall, the research aims to encourage the use of technology in schools in order to help those students in Saudi Arabia, so that they may achieve their desired outcomes, as well as continue to improve their abilities. He used semi-structured interviews and observations to collect his data, interviewing and observing four mathematics teachers and 12 students at elementary school. Observations were crucial for seeing the effect of technology on the mathematics learning of Saudi primary grade students with mathematics difficulties. However, observation may not have been enough because he wanted to investigate the teachers' usage of technology with those students, and their perceptions about using it, and for these objectives, conducting face-to-face interviews would probably have been the best approach. The study found evidence to suggest that there were positive effects to using technology on the mathematics learning of Saudi primary grade students with mathematics difficulties. These include technologies that can give meanings to numbers, which can remove any necessary barriers to further learning and can enhance the latent strengths of students with mathematics difficulties, thereby boosting their confidence; some technologies can help such students to remember what they have learned (because the brain can more easily understand and remember visual information).

Although that study has confirmed the positive effects of technology on learning, one of the teachers investigated did not use it with his students. However, he has now changed his mind about the value of technology and has begun using it. Therefore, the researcher suggested that further study could focus on the obstacles to using technology in primary schools in order to help students with mathematics difficulties in the Saudi Arabia because his study found evidence to suggest that there is a variety of obstacles, including the lack of teacher training in using it, especially with such pupils. It is evident that the current study extended the recommendations of above study.

3.8 Barriers to using technology for teaching and learning mathematics

In the light of the use technology, it has been discovered by researchers that teachers rarely utilise technology in the classroom environment. For instance, in a large-scale survey of teachers, students and administrators by the Gates Foundation, Abbott (2003) shows that more than 53% of teachers do not use technology regularly to help their students in the classroom. In 2005, another survey (by CDW-G) found that 80% of teachers use computers for administrative tasks only (National Teacher Survey, 2005).

In this section, I examine certain researches in order to gain a better idea of some of the barriers to adopting and using technology for teaching and learning mathematics, with the ultimate aim of breaking down those barriers among teachers and technology in schools.

3.8.1 The lack of training teachers to use technology

Many study found that technology will not enhance learning unless teachers have training on how to use it appropriately. Accordding to Jessica (2015) study there is an attempt to comprehend the viewpoints of teachers as to how technology and the media have affected mathematics teaching. The information in this qualitative research was obtained by interviewing eight teachers of mathematics, all of whom have been in teaching for a minimum of 15 years, and who also utilise media and technology in the classroom. The purpose of the research is to enable students to be acquainted with the impact of technology on the educational structure, and of particular significance, its impact on each person's learning progression. The summary of this analytical study implies that when technology and media are utilised in the classroom environment, they do not inevitably affect the development and success of the student. A deficiency in teaching training could be responsible for this. Despite the fact that teachers are not utilising technological methods and media comprehensively, they remain conscious of the advantages that emerge. They are also conscious of the deficiency in their training and have a desire to acquire more knowledge. It is evident that the above study adopts an interview and the current study applied semi-structured interviews and observations.

Akkaya (2016) in his study, sought to examine how teachers' viewpoints have changed concerning the utilisation of technology following their training on the co-ordinating technology with the teaching of mathematics. Pre-service teachers participated in a training programme that has been prepared for this purpose. This programme included, co-ordinated technology, didactics and awareness of content. In the course of this research, the exploratory sequential mixed system was employed. This is a system which includes both quantitative and qualitative research methods. In the quantitative research measure, pre-test/post-test exploratory plans without any control groups were utilised, but in the qualitative measure pre-service teachers' opinions were obtained. A total of 34 pre-service teachers participated in the research which was held at a state university Middle School Mathematics Teaching Department in the spring semester of the academic year 2013-14. Information was obtained by utilising the Perception Scale for Technology Use as well as by interview forms. Quantitative data was examined by employing the t-test and the Perception Scale for Technology Use while the preferred option for examining qualitative data was content analysis. The results of the study revealed there to be important variations in the understanding of pre-service middle school teachers of mathematics concerning the utilisation of technology which followed their training in the incorporation of technology in the teaching of mathematics. On the basis of the results, it was deduced that training, which embodies educational, technological and content awareness is supplied within the teacher training programme, and advances the understanding of pre-service teachers regarding the utilisation of technology in the field of the teaching of mathematics. The present study differs from this study, because it is evident that the above study was implemented in non-Arab countries and this study used qualitative and quantitative approaches, and the current study used only qualitative approaches. Moreover, this study reflected the experience of primiary school, but the present study focused on middle school.

A study in the Kingdom of Saudi Arabia by Alabdulaziz (2013), which used semi-structured interviews with four mathematics teachers and 12 students at an elementary school in Saudi Arabia, sought to build a picture on the effect of using technology with pupils who have mathematics difficulties from the teacher's point of view. The interviews consisted of eight questions. In the answers to the first question, the teachers' perceptions on the use of technology with those pupils varied. It was apparent that these teachers had experience with different types of technology software. Teacher 4's experience differed from that of Teachers 1, 2 and 3. This teacher does not use technological aids for three reasons: firstly, lack of teacher training; secondly, there is no reward system for encouraging teachers to be innovative; and lastly, he prefers the traditional blackboard for explaining step-by-step mathematical answers to a student struggling with arithmetic. Teacher four further added:

> *I am very aware of the problems that plague traditional schooling, but I feel that technology could push me out of my job, because buying and implementing technology is more cost-effective than hiring teachers. I hope to use it as a supplement to teaching rather than an alternative to teachers, especially with those students who have dyscalculia.*

With regard to the three other teachers had not been trained on how to use technology effectively in the classroom when they were at university. The researcher noticed that those teachers were trying to use technology with their students because they understood that it can be very useful for those pupils who have difficulties with maths. It is important to acknowledge that the training of teachers will play a crucial role in increasing the use and effectiveness of technology in education. It is worth noting in that study that teachers rely heavily on their students for information about technology, such as how it works, how to conduct an Internet search for general information, or how to send and receive emails. Here, students play a vital role in the improvement process, although adding to the major challenges facing teachers when using technology with those students. The researcher found that all three teachers felt the need for more training in using technology in the classroom, and they feel that this is a major obstacle in their use of technology. For example, one teacher said:

> *Technology training is the main factor that could help me develop positive attitudes toward integrating technology into my mathematics teaching.*

Another one said,

> *Appropriate and integrated use of technology impacts every aspect of mathematics education… I do not have any training on this.*

Wachira and Keengwe (2011) investigated urban school teachers' perspectives on barriers that hinder technology use in mathematics classrooms. This study employed a varied methodology which coordinated qualitative and quantitative elements. A total of 20 teachers participated, 15 females and 5 males. Certain barriers to the improving and increasing the use of this technology were discovered by the study; examples of these being the time factor and the restricted number of technology tools, additional the scarcity of teachers trained for this technology, and the lack of a reward system for imaginative teaching. The researchers found that there are two types of obstacles. The first is external: the lack of availability of technology, unreliability of technology, and the lack of technology support and technology leadership. The second is internal: the lack of time, the lack of knowledge, and scarcity of confidence and had anxiety in teaching involving technology. With regard to lack of knowledge, teachers responded that a lack of training in the relevant technology as the main cause of the lack of technological knowledge. The majority of the teachers indicated that their training had been generic and not specifically geared to particular technology integration. It was explained by one teacher that many teachers were unaware of how to involve their students with technological learning. Actually, I find that this study used qualitative and quantitative approaches, and the current study used only qualitative approaches. Moreover, this study reflected the experience of both genders, but the present study focused only on males.

To return once again to the role of interactive whiteboard in mathematics education, I find that the most common issue raised by teachers and students is the need for adequate training and support in how to use IWBs in order to take full advantages of this technology and to apply it to benefit the students in the classroom. Levy (2002), in his study, found that teachers who are inexperienced with IWBs lacked sufficient knowledge on how to set up technological devices, leading to constant interruptions during the lesson. When Levy interviewed the teachers and students in that study, he also found that both parties lacked a sense of comfort with using technology for teaching and learning, because of these interruptions. Glover and Miller's study (2001) incorporated interviews in which the views of both teachers and students were clarified regarding the effects of using IWB technology in school as well as the problems and potential associated with the technology. The researchers found that the initial training provided by IWB suppliers, with their 'slick presentation and high-quality prepared materials', was the main driver in increasing the motivation of teachers to use technology (Glover & Miller, 2001, p. 261).

A large body of literature supports the idea that lack of teacher training on how to use technology effectively in the classroom is the major factor placing a barrier in the way of maths teachers, preventing them from enjoying the advantages of technology. However, some teachers, even though they have mastered basic computer skills following their initial training, find that another barrier is lack of technical support. It is important to look beyond the attainment of basic computer skills, and to examine the level of follow-up support after having trained teachers to use technology with their students (O'Dwyer, Russel, & Bebell, 2004).

3.8.2 Lack of technical support

Another barrier originates from a lack of technical support in school. Mumtaz (2000) indicates a scarcity of on-site support as a reason quoted by teachers for not using technology in the classroom. An example of this is highlighted in Butler and Sellbom (2002); it took three weeks to replace an expired projector bulb. Snoeyink and Ertmer

(2001) discovered that teachers who attempted to perform a function on a computer failed as a result of technical issues, and that they would then not use a computer for a number of days. Sharing a similar view, Jones (2004) reported that there is a close relationship between technical assistance and barriers; barriers in this case represent a lack of technical support, and teachers will be discouraged from using technology if they know that no one will be on hand to offer immediate technical support. Jones (2004) agrees that, if technical support is lacking at school, it will likely be the case that technical maintenance is not executed on a regular basis, which leads to a greater risk of technical failures.

A study in the United States by Hsu (2016) being a mixed-methods research, the intention of which was to examine the current practices, beliefs and obstacles regarding the technological incorporation ranging from teachers of Kindergarten up to Grade Six in the United States Midwest. Three data gathering methods were employed, namely surveys conducted online involving 152 teachers, in addition to observations of and interviews with eight teachers The findings revealed that most teachers had constructivist pedagogical beliefs regarding technological incorporation. This research discovered that the teachers having constructivist pedagogical beliefs regarding the utilisation of technology had high self-efficacy beliefs regarding such utilisation placed a positive value on the utilisation of technology, and had at least two instances of high-level learning within their lessons. Language Arts was the subject which attracted the greatest attention for technological incorporation. The following four obstacles identified by the study were; deficiency in teacher training regarding technology, deficiency in computer proficiency, deficiency in technological support for teachers and shortage of time for teachers to introduce technology-incorporated lessons. Indeed this study used qualitative and quantitative approaches, and the current study used only qualitative approaches. Moreover, this study used a very large sample compared to the current one.

Another study by Alghamdi (2016) sought to assess the technique employed by Saudi teachers in utilising IWBs in the classroom environment and to recognise the problems they experience in the utilisation of such technology. This research was undertaken in Jeddah city, Saudi Arabia. A mixed-methods technique, both qualitative and quantitative, was utilised in the present study, by employing three approaches. These are a questionnaire (online and paper-based), semi-designed consultation and observation inside the classroom. The questionnaire, specifically written for this research, was completed by 587 teachers (286 male and 301 female) from primary schools within Jeddah city. The three main problems encountered by the participating Saudi teachers when employing IWBs were; scarcity in training courses' availability, technical difficulties in the utilisation of IWBs and deficiency of help and encouragement. Contrastingly, the three least encountered difficulties were; students experiencing problems with IWBs, the position of IWBs and problems in the incorporation of IWBs in conducting lessons. Indeed this study used qualitative and quantitative approaches, and the current study used only qualitative approaches. Moreover, this study used a very large sample compared to the current one. Furthermore, this study reflected the experience of both genders, but the present study focused only on males.

3.8.3 Teacher attitudes and beliefs about teaching with technology

Simpson, Koballa, Oliver, and Crawley (1994) indicated that attitudes can be construed as certain sentiments as to whether someone likes or dislikes something. Consequently, teachers' attitudes and opinions regarding technology can be another obstacle to the incorporation of technology (Hermans, Tondeur, Valcke, & Van Braak, 2006). Because the attitudes of educators play a significant part in the area of educational interaction, as well as in teaching choices, these are basic in analysing the consequences of the results of classroom technological integration (Albion & Ertmer, 2002). Nevertheless, the software being available and the teachers being ready to use the software can positively impact the attitudes of teachers regarding the implementation of technology in the classroom (Sepehr & Harris, 1995).

Kersaint, Horton, Stohl, and Garofalo (2003) discovered that teachers having positive attitudes are more comfortable when they use technology and usually include it in their teaching work. On the other hand, although a school may have an appropriate level of technology utilisation, it may fail to offer technology-supported learning, if the teachers themselves are not have a positive attitude towards technology. In this case, school head teachers may play an important role in changing teachers attitude and belief through providing support and enhancement, rather than supervision them only. School principals need to offer personal advice to teachers and staff, not only act as official supervisors, if they want to bring about a change in the perceptions of teachers (Kim, Kim, Lee, Spector, & DeMeester, 2013).

The reasons have been offered as an explanation for this barrier

Ertmer, Addison, Lane, Ross, and Woods (1999) examined the barriers to using technology in the classroom, with seven primary teachers, through interviews and observations. The researchers found that there are two types of obstacles. The first is external; this includes the lack of resources, insufficient time to fully prepare for an instructional task and lack of administrative support. The second is internal; one of the aspects researchers mean by internal is negative beliefs on the part of teachers toward the use of technology. One reason has been offered as an explanation for this barrier; according to Handal (2004), some teachers, while they were studying at schools or college, found that no technology was available to them. Thus, they tend to employ a certain pattern of teaching that obviates the need for technology. For example, the average age of teachers in New South Wales is 47, meaning that they studied teaching before many technologies had become available (Godfrey, 2001).

Another study, by Norton, McRobbie, and Cooper (2000), investigated the reasons why mathematics teachers do not use technology in their teaching in order to support students; their research was conducted at a school where mathematics teachers rarely use technology with their students, despite the availability of hardware and software. According to the findings of the study, the resistance of individual teachers was linked to their beliefs about the teaching and learning of mathematics and their existing pedagogies. This involves their ideas about tests, apprehensions about time restrictions, and preference of certain text resources. The study also concluded that teachers with transmission/absorption views of teaching and learning, and pedagogy focused on the educator and the content, had an obscured view of the prospects of using computers in the area of teaching and learning mathematics. By way of comparison, a teacher who holds a view of teaching methods in line with the social constructivist learning theory and learner-focused education displayed a broader view of the computers’ prospects in the teaching of mathematics.

In the light of teacher beliefs, researchers suggest that the beliefs of the educator could serve as a crucial element in assisting or impeding the incorporation of technology by the educators (for example, Cuban, Kirkpatrick, & Peck, 2001; Dexter, Anderson, &

Becker, 1999; Niederhauser & Stoddart, 2001; Windschitl & Sahl, 2002). In the view of Ertmer (2005), to utilise or not technology for instruction purposes is a decision that eventually rests on the educators themselves as well as on their beliefs towards how effective technology is. In a study by Sugar, Crawley and Fine (2004), beliefs held by educators about the decision to embrace technology were discussed. The qualitative and quantitative data gathered were sourced from educators from four schools in the south-eastern part of the USA. Based on overall findings, the decision to embrace technology was impacted by the individual stances of the educators on the incorporation of technology. Their stances were shaped by virtue of certain fundamental personal beliefs they hold about the effects of technology incorporation. Elements of inconsequential impact on the educators' decision to embrace technology included outside support from key individuals as well as contextual resources, such as funding. Their recommendation, based on their findings, was that head teachers should collaborate closely with educators to address their beliefs and apprehensions about the incorporation of technology as well as offer them a significant degree of personal support and resources. Indeed, I see that this study used qualitative and quantitative approaches, and the present study used only qualitative approaches.

Miller et al. (2003) stated that the technology-related beliefs of educators consist of three components, which are connected, but still independent; the first is pedagogical beliefs on tuition and learning, the second self-efficacy beliefs on the utilisation of technology, and the third beliefs on the perceived value of computer use in the student learning process. Another research study, conducted by Russell, Bebell, O'Dwyer, and O'Connor (2003), discovered that these three elements played the main role in the prediction of the incorporation of technology by the educators in the classroom.

On pedagogical beliefs about teaching and learning, it can be argued that constructivist pedagogical beliefs held by educators about the teaching and learning process play an influential part in the determination of strands of utilisation of technology in classrooms (Higgins & Moseley, 2001; Inan & Lowther, 2010). Honey and Moeller (1990) established that a successful technology incorporation into instruction was achieved by educators holding constructivist-oriented pedagogical beliefs. As suggested by Ertmer (2005), technology was more likely to be adopted in the classroom by educators holding robust constructivist pedagogical beliefs than by educators with traditional-oriented pedagogical beliefs. Likewise, following their examination of the influence of the intricate relationship between the educators' ways of thinking and the adoption of technology, Sang, Valcke, van Braak, and Tondeur (2010) suggested that educators' constructivist pedagogical beliefs have a significant impact on their potential utilisation of technology. Additionally, Sang et al. established that educators holding more robust constructivist pedagogical beliefs had a greater tendency to incorporate technology into instruction, as compared with educators who did not have those beliefs. Nonetheless, Sandholtz and Reilly (2004) suggested that educators with constructivist beliefs might not necessarily be active tutors, given the possibility that they can be unskilled in the utilisation of technology or do not have enough time in the classroom.

Teachers' self-efficacy beliefs about the utilisation of technology can play a crucial role influencing in the practices of educators in relation to the employment of technology. In the definition by Bandura (1997), self-efficacy is individual beliefs about one's ability to learn or execute tasks according to certain standards. Putting it more explicitly, the self-efficacy beliefs of educators consist of beliefs about what they are able to achieve with the incorporation of technology in the classroom, as compared to their information about what to do (Ertmer et al., 2003). Based on findings by researchers (Albion, 1999; Lumpe & Chambers, 2001; Marcinkiewicz, 1994; Oliver & Shapiro, 1993), self-efficacy beliefs of educators, or their confidence about the utilisation of technology, play a crucial role in the prediction of the incorporation of technology in the classroom by educators.

On beliefs about the perceived value of computers for student learning, Newhouse (1998), based on a survey he conducted, involving 60 Australian educators, discovered that tutors were unwilling to apply technology in their classroom, even those educators who were technically skilled. In the educators' views, the use of computers in teaching is unbeneficial, and the application of technology plays an extremely restricted part in the classroom. According to the author, preferring conventional methods of teaching was one of the reasons behind the educators' unwillingness to adopt technology. I see that this study used a very large sample compared to the current one. A survey involving 2,170 school teachers by Niederhauser and Stoddart (1994), concluded that there were two groups of educators. The first group, which was linked to constructivist-oriented views, believe that computers are instruments employed by the learners to gather, analyse, and supply information. Meanwhile, the second group, which was linked to transmission views, perceive computers as teaching equipment that can be employed for supplying information and instant support, as well as tracking the progress made by the learners. I see that this study used a very large sample compared to the current one.

3.8.4 School leadership

3.8.4.1 What is leadership?

Defining leadership in terms of learning and technology use, Maurer and Davidson (1998) state: "The fundamental values and beliefs of contemporary power -based, formal leadership and traditional or transmission models of teaching and learning are no longer relevant" (p. 13). Creighton (2003) similarly notes that " . . . *school leadership as practiced by today's school principal is outdated unless it helps faculty address the great challenges presented by the introduction of technology in our schools*" (p. 1).

3.8.4.2 School leadership' attitudes toward technology

From the viewpoint of teachers, the attitudes of school headmasters on technology play an extremely significant role in the encouragement of technology incorporation into school (Atkins & Vasu, 2000). Baylor and Ritchie (2002) examined the effect of seven aspects linked to school technology (planning, leadership, curriculum alignment, professional development, utilisation of technology, teacher open attitude to change, and teacher use of computers outside school). Powerful leadership in technology was found, through interviews with teachers and administrative staff, to have an impact in students' acquisition of content. Moreover, when head teachers had a positive stance towards technology, this promoted the integration of technology into the classroom and spurred teachers and students to utilise technology more often (Baylor & Ritchiem, 2002).

Another study discussed the effect of head teacher's technology training on the integration of technology into schools. For example, Dawson & Rakes (2003) conducted a study entitled "The influence of principals' technology training on the integration of technology into schools". The intention of this study was to analyse if training in technology given to principals had any effect on the incorporation of technology in the classroom. The standards of technology incorporated into the schools' curricula concerning the volume and kinds of training given to K-12 school principals were analysed in this study. In addition to the standard of technology, this study analysed regarding the demographics listed below: age, sex, principal's length of time of experience in administration, size and level of school. The study discovered important statistics regarding the among and kinds technological training received by the principals, stating each of these may impact on the standards of incorporation into a school's curricula. It was revealed that the age of the principal has a major effect on incorporation of technology into the curriculum. Dawson & Rakes (2003); they believed that successful implementation of technology was dependent on the age and attitude of the principal. According to the researchers, the younger the principal, the more successful the implementation, and the older the principal (aged between 41-55 years) the greater the resistance to incorporating technology in the school.

3.8.4.3 Leadership role in technology

As suggested by Gibson (2002 cited in Smith-Salter, 2004), it has not been long since the importance of the head teacher in the integration of technology into school emerged; literature available on this specific role, which head teachers are expected to play, is relatively scarce. In an endorsement of Gibson's view, Slowinski (2000) stated that the part that should be played by principals has been debated on a limited scale, at a time when the use of school computers, which represents a vital matter, transitions from a sheer issue of obtainability to a more essential one of how to achieve a productive incorporation of technology into taught curriculum. Nonetheless, it has been long since both researchers and practitioners established that, for a school to improve, it is important that attention is paid to the head teacher's role (Barth, 1980; Glickman, 1990; Howe, 1993). The role played by head teachers is vital, or the most vital, in ensuring that initiatives, prospected to achieve better school functioning and teaching opportunities for learners, are successfully executed and maintained (Razik & Swanson, 2001).

Kafyulilo , Fisser and Voogt (2016) examined the resumption of the utilisation of technology in the teaching of mathematics and science by teachers who participated in a professional development course between the years 2010 and 2012. It was presupposed that the resumption of the utilisation of technology would be impacted by the professional development course and also by individual, established and technological parameters. Three school heads and twelve teachers were involved in the research in which data was gathered by a consultation. It was revealed by the research that the resumption of the utilisation of technology was different in the case of teachers who had participated in the professional development course. Although every teacher declared an increase in abilities and awareness as a result of the professional development course and was also positive regarding the utilisation of technology in education, only a certain number of teachers persevered in utilising technology. The research indicated that regardless of the problems that all participating teachers experienced in utilising technology in teaching, for example shortage of time, electricity supply issues and oversized classrooms, a critical element in the resumption of the utilisation of technology by teachers is support from school management. I can see that the above study' sample focused on teachers and head teachers, but the current study concentrated on teacher only. However, the study could have included students and head teachers if there were no restrictions of time.Mutohar, (2012) states that if teachers are enthusiastically encouraged to utilise an interactive whiteboard, then there is a greater change that they will use it. Additionally, he proposes the concept that the availability of encouragement for teachers in technological incorporation is a significant procedure. In a perfect world, schools ought to supply technological assistance, for instance to train teachers to solve problems and to surmount instructional difficulties.

Nonetheless, it is necessary for head teachers to possess adequate technological knowledge which serves as a guiding principle for them in the process of decision-making (Holland & Moore-Steward, 2000). It is important that head teachers are aware of how highly effective planning is, and how necessary the production of a technology strategy is, in order to support instruction-based objectives and school's goals (Holland & Moore-Steward, 2000). It is important that head teachers hold powerful future visions, are technologically knowledgeable, and grasp the teaching that helps introduce creativity into the classroom and into the process of student learning (Hughes & Zachariah, 2001). A thoroughly-detailed qualitative study by Bowman, Newman, and Masterson (2001) traced how a district's technology strategy had progressed in the span of three years; the strategy was drafted as part of a district endeavour that was recently approved and was aimed at the incorporation of technology. The sources of data that were gathered were observations, notes from the field, focus groups, interviews, and group discussion. Employing documented qualitative approaches, the data were analyzed. The processes and essential administrative activities of the district were specified; they involved planning related to technology, training for professional development, creation of a curriculum that is assisted by technology, and application of technology in the classroom. In a vital conclusion, Bowman et al. stated that it is important that head teachers possess the knowledge and abilities needed to introduce technology which plays a role in providing support and training for educators to successfully incorporate technology.

Overall, this section provided a review of available literature on the part played the head teachers in technology incorporation. Related current research work conducted in the education, technology and leadership fields has informed this review of literature. A highly important conclusion based on this review of literature is the idea that head teachers play an essential part in establishing whether or not it is effective to incorporate technology into the classrooms.

3.9 The research questions and conclusion to literature review

A number of substantive conclusions can be drawn from the literature review. Firstly, as a theoretical framework for undertaking this research, the Concerns-Based Adoption Model (CBAM) (CBAM: Hall & Loucks, 1978; Sashkin & Ergermeier, 1993) and the Technological Pedagogical Content Knowledge (TPCK) (Shulman, 1986; Mishra & Koehler, 2006) are both selected. To understand the challenges those teachers face when use technology, CBAM is adopted. The term TPCK is used to describe the knowledge that is required by the teachers for effective integration of technology into educational practices. This study uses TPCK as a framework to understand mathematics' teachers needs so that they can overcome the hurdles of introducing technology in classes.

Secondly, we have found how the combination of technology and both constructivist and behaviourist theory has the potential to revolutionize the school reform process. This is because technology can be used as a tool to facilitate the implementation of constructivist strategies in order to support students who suffer from mathematics difficulties. In addition, the literature demonstrates how technology, over time, has facilitated the implementation of these theories in mathematics education. The potential benefits will greatly encourage teachers to use technology in conjunction with constructivist teaching because they know that constructivism has emerged as one of the greatest influences on teaching students, as it firmly places educational priorities on the learning process. I can gain an overview of this theory from a number of researchers who have been interested in this theory, such as Dewey (1961), Piaget (1977), Bruner (1983), Vygotsky (1978a, 1978b), Karagiorgi and Symeou (2005), Kanuka and Anderson (1999), Brooks and Brooks (1993), Naylor and Keogh (1999), Glasersfeld (1995) and Jones and Araje (2002), as well as from researchers who were keen to clarify the role of these theories in technology, for example, Morrison et al. (1999), and in mathematics education, e.g., Raghavan (1994), Ernest (1991) and Lakatos (1976).

Thirdly, a number of studies have demonstrated that knowledge of the common difficulties and misconceptions that students have in mathematics (and the causes of those problems) can help teachers make informed choices pertaining to the most appropriate teaching method for each student (e.g., Black & Wiliam, 1998; Schmidt et al., 1996; Stigler & Hiebert, 1999; Williams & Ryan, 2000). There are quite common difficulties facing students in mathematics, such as subtraction (Resnick, 1982), mathematical equivalence (Perry et al., 1988), fractions (Chapin & Johnson, 2000), multiplication (Sadi, 2007; Rees & Barr, 1984; Bell et al., 1981), division, and place value (e.g., Carpenter & Moser, 1984; Cobb & Wheatley, 1988; Hiebert & Wearne, 1992). This research focused on two areas of difficulties: multiplication and subtraction (see Table 3.5), because both of them are considered common mathematics difficulties facing students at primary schools in the Kingdom of Saudi Arabia. In addition, the study may include another area of difficulties, if there are no time constraints.

Sample	The areas of difficulty	
Six teachers	Multiplication	Subtraction
Teacher one	○ The students failed to understand that any number multiplied by zero equals zero. ○ The students found it difficult to understand that multiplication does not always make results bigger.	-
Teacher two	-	○ The students did not understand how to borrow from zero in subtraction calculations.
Teacher three	○ The students failed to understand that any number multiplied by zero equals zero. ○ Two students found it difficult to deal with subtraction tasks such as 20 minus 13, for which	-

	they took a long time to answer, and answered it wrong.	
Teacher four	-	○ The students did not understand how to borrow from zero in subtraction calculations.
Teacher five	○ Understanding that any number multiplied by zero equals zero.	-
Teacher six		

Table (3.5): The areas of difficulty that the students had in mathematics

Fourthly, in the Role of Technology in Teaching and Learning Mathematics section, we learned that technology is playing an increasing role in mathematics education, starting with radio in the 1920s; although somewhat ineffective today, radio has created a legacy for itself through the development of other technologies such as television. One of television's characteristics is its visual aspect, which confirms the old adage that values a picture at a thousand times the value of a word. From the late 1970s until now, the computer has been the focus of attention; it fulfils many roles at all levels of education in primary schools, and has had a deep impact on mathematics education. By the late 1990s, another technology had emerged, called the interactive whiteboard (IWB), and many researchers have attested to the depth that this tool can promote in classroom practice, especially in mathematics (e.g., Carson, 2003; Edwards et al., 2002; Latham, 2002; Damcott et al., 2000; Bell, 2002; Levy, 2002; Thomas, 2003; Clemens et al., 2001). In this study, the participants used a variety of technologies to help their students with mathematics difficulties, such as computer, projector, IWB, TV and video camera.

Fifthly, when I questioned how to exploit the established role of technology in mathematics education to address difficulties in mathematics (and how to use it to its fullest advantage), I found many studies that have already addressed this issue, for instance, the studies conducted by Torff and Tirotta (2010), Taylor (2009), all of whom examined the impact that technology has on learning mathematics. The results of those studies demonstrate that the use of technology increases motivation and self-efficacy in mathematics learning. Other studies, such as Bidaki and Mobasheri (2013), have found that the role of technology is to save teaching time, and to discourage and minimize adverse outcomes for those students with difficulties in mathematics, especially in early intervention Prince Edward Island (2011). In addition, a study by Alabdulaziz (2013) found that the benefits of technology in the learning of mathematics are giving meanings to numbers, building student confidence and helping them remember something they had already learnt. Finally, Wilson et al. (2006) found the Number Race software to be a powerful tool in mathematics, helping students to simplify their understanding of mathematical operations when more complex skills are required. These studies also indicated the significant positive effects of using technology such as the interactive whiteboard, upon which I will focus in this study. The current study is consistent with all of the above studies in regard of the view that technology brings positive outcomes into the classroom; this gave the researcher the motivation to investigate the obstacles to using technologies in primary schools in order to help students with mathematics difficulties in the Kingdom of Saudi Arabia.

Sixthly, many teachers face a variety of challenges when trying to effectively use technology into their classroom. The first barrier to using technology in teaching and learning mathematics is the lack of training courses for teachers on how to use technology effectively. This barrier was demonstrated in a number of studies, such as Alabdulaziz (2013), Wachira and Keengwe (2011), Levy (2002), and Glover and Miller (2001). The second barrier is the lack of technical support; this was addressed in Mumtaz (2000), Snoeyink and Ertmer (2001), Jones (2004), Hsu (2016), and Alghamdi (2016). The third barrier that affects the use of technology with these students is the negative attitudes and beliefs of teachers towards the use of technology generally. Some studies have investigated this barrier, such as Norton, McRobbie and Cooper (2000), Ertmer et al. (1999), Dawson & Rakes (2003), Baylor & Ritchie (2002), and Atkins & Vasu (2000). In the light of teacher belief, researchers suggest that the belief of the educator could serve as a crucial element in assisting or impeding the incorporation of technology by the educators (for example, Cuban et al., 2001; Dexter et al., 1999; Niederhauser & Stoddart, 2001; Windschitl & Sahl, 2002). The last barrier is the school leadership' attitudes toward technology: this was demonstrated in Atkins & Vasu (2000) and Baylor & Ritchie (2002).

Many and various salient issues have arisen from the literature review, relating to the barriers to using technology for teaching mathematics to those students who have mathematics difficulties, and some researchers have clarified a number of related obstacles. However, the present study differs from the previous ones that have been reviewed so far, apart from the fact that this study attempts to address the issue more rigorously as follows.

1- The previous studies were implemented in non-Arab countries, with the exception of one study that focused on investigating the effects of applying technology on the mathematical problem-solving abilities of primary school students who have mathematics difficulties. The researcher used semi-structured interviews and observations to collect his data. The interviews consist of eight questions, only one of which concentrates on the major challenges facing teachers when using technology to address mathematics difficulties. Conversely, the main aim of the present study, having affirmed the positive impact of technology, is to focus on:

- Identification of obstacles to the use of technology in primary schools in order to help students who have difficulties in mathematics.
- Understanding why some mathematics teachers are overcoming the obstacles they face when using technology to benefit their students.
- Understanding why some mathematics teachers who do not use technology with their students do not try to overcome the obstacles that prevent them from using technology.
- Determining whether the use of technology has a positive effect on students who face difficulties in mathematics.

2- The current study extended the recommendations of previous studies, such as that of Alabdulaziz (2013), the researcher who found that, although the study has confirmed the positive effects of technology on students with mathematics difficulties, one of the participating teachers did not use it with his students for three reasons. First, the teacher simply needed to be trained to use the technology. Furthermore, there is no reward system in place for innovative teaching. Additionally, he thought that the traditional blackboard would make complicated problems more solvable. But now he has changed his mind about the value of technology and began using it. Therefore, the researcher recommended that further research work could focus on the obstacles of using technology in primary schools to help students with mathematics difficulties in Saudi Arabia. As a result, the current study aims to improve the quality of teaching mathematics in these two schools in Saudi Arabia through investigating and understanding the barriers that teachers face when using technology in their classrooms in primary schools, and particularly why some overcame the obstacles and why others did not. The results of this study are expected to assist the educational supervisors for these two schools in reaching a clarification regarding the hurdles that face teachers who teach mathematics and help them overcome those problems.

3- Many studies focused on middle and secondary levels, but the current study focused on the elementary level only. As we know, the groundwork for future learning and future skills are laid by primary education because the skills and values that are instilled there are absolutely foundational. Primary education serves as the base on which students build upon during further schooling and hence the choice of elementary school is important.

4- This study adopts the qualitative research methods to address the research questions. In order to collect the qualitative data, the research method applied will be that of semi-structured interviews and observations, which have not previously been used in Saudi Arabia by researchers in this context.

5- All the previous studies reflected the experience of both genders, but the present study will focus only on males because the official religion of Saudi Arabia is Islam, meaning that classes must be segregated taught by a teacher of the same gender. As a result, a male researcher will only have access to boys-only schools.

Overall, there is an apparent gap between the amount of technology available in the classroom, and the teachers' use of technology to help students, despite the fact the previous research has verified that technology has a positive impact on students who have mathematics difficulties. However, one reason for this gap is that teachers face a number of barriers when using technology in the classroom. In view of the gaps, this study aims to investigate the barriers that teachers face when use technology in their classroom in the Kingdom of Saudi Arabia, and why some overcame obstacles and why others did not. Thus, there are two key questions:

- Why are some mathematics teachers overcoming the obstacles they face when using technology to benefit their students?

- Why do some mathematics teachers not succeed in overcoming the obstacles that prevent them from using technology to benefit their students?

As mentioned in the previous chapter, education today clearly ranks as a top priority for Saudi Arabia; this is apparent in the annual budget for education, which now has the largest proportion of government spending. However, Saudi students' achievements in education have not been as high as government officials had anticipated.

The next chapter will discuss the methodology used in this study and the methods employed in collecting the data, in an attempt to address the research questions, thereby allowing Saudi Arabia to keep pace with more advanced countries.

The structure of chapter four

This chapter presents the method and procedures used to obtain the necessary data for the current study, which divided into ten main sections as follow:

4.0 Introduction	4.1 Definition of methodology	4.2 Research questions	4.3 The role of the researcher
4.4 Research approach	4.5 Data Collection Methods	4.6 The sample	4.7 Data Analysis
	4.8 Ethical Considerations	4.9 Summary of methodology	

4.10 Conclusion

Chapter Four

Research Methodology

4.0 Introduction

This chapter presents the method and procedures used to obtain the necessary data for the current study. These include the role of the researcher, the research design and methodology, data collection methods, and the sample of the study. There follows a consideration of the application of data analysis in the study and finally, the researcher discuss the ethical considerations of this research.

4.1 Definition of methodology

The approach that is used for shifting from the inherent assumptions towards designs of research alongside the collected data is called research methodology (Myers, 2009). Additionally, methods of research are approaches and procedures that researchers use to gather information (Cohen, Manion, & Morrison, 2007). Mouton (1996), defines methodology as the techniques that are used to accomplish a given task during research. Notably, organized approaches that offer support to one another and are critical to the acquisition of information as well as outcomes that reflect the research questions along with objectives is what constitutes research methodology (Henning, Rensburg, & Smit, 2004). Wellington (2003) "*described methodology as an activity or business of choosing, reflecting upon, evaluating and justifying the methods you use enabling researchers to describe and analyze these methods, throwing light on their limitation and resources, clarifying their presuppositions and consequences, relating their potentialities to... the frontiers of knowledge*" (p.22).

4.2 Research questions

The aim of this study is to improve the quality of teaching mathematics in these two schools in Saudi Arabia through investigating and understanding the barriers that teachers face when using technology in their classroom in primary schools, and particularly why some overcame obstacles and why others did not. Thus, there are two key questions:

1. Why are some mathematics teachers overcoming the obstacles they face when using technology to benefit their students?

2. Why do some mathematics teachers not succeed in overcoming the obstacles that prevent them from using technology to benefit their students?

4.3 The role of the researcher

Interpretations form the basis of qualitative research; in which the researcher engages in holding interviews, taking observations and analysing context; and all these aspects need a degree of data interpretation (Pratt, 2012). As suggested by Hammersley (1993), the results of research work differ depending on the individual undertaking it. They might be slight, but differences would still be there. Although they might not highlight a different story, differences could be related to matters, such as 'emphasis and orientation'. Because of the researchers' role in the research work they are conducting, there would always be differences. Thus, I will explain in this section a portion of my role as the researcher.

The aim of this study is to improve the quality of teaching mathematics in these two schools in Saudi Arabia through investigating and understanding the barriers that teachers face when using technology in their classroom in primary schools, and particularly why some overcame obstacles and why others did not. Thus, the role of the researcher in this study was to achieve the aims of this research through selecting the appropriate data collection method and its analysis, and to ascertain its validity, reliability, dependability and confirmability.

The role of the researcher was clear in the interview, which started with the interview questions the design of which was based on predetermined subjects; this means that the interview questions were prepared before the interview. However, semi-structured features of the interviews lead to the emergence of new questions from the responses of the interviewees (Zhang & Wildemuth, 2009). Therefore, more detailed questions were asked after the general ones, first those related to what the interviewee said and then the next questions on the list that allowed the interviewees to influence the content of the interviews within the general framework proposed by the researcher and, prioritizes their perspectives on the problems raised. During the interview, the researcher ensured that all interviews were conducted in a secure and good environment with enough space. In addition, care was also taken to avoid leading the teachers towards any particular viewpoint, so responses to questions were accepted as they were given and probing questions were asked simply to ascertain the reasons for what the teacher thought. Additionally, in some cases, teachers were asked to comment on the transcripts to ensure that the meaning constructed by me was the same as that constructed by the teachers.

With the help of the interview method, the role of the researcher in the observations was to adopt a thoroughly explanatory direct observation technique as a foundation for the evidential data gathered for the current study. This gave the researcher a better understanding of the information gathered through the interviews. This means observation is a good way of crosschecking people's answers to questions. Its use may also generate questions for further investigation and help form future discussions or frame questions in case of inconsistencies between what the interviewer of a key informant observes and what the respondents are saying. Although during the first meeting with each teacher I introduced myself as an academic researcher and explained my research in detail, I was very keen to be clear with the teachers, before the observation, that my role during the observation was to achieve my research objectives which would help me to answer my research questions. The reason for this clarification was to make them not concerned while I took note in the classroom, as I noticed that some of them thought that I might be evaluating them secretly. The concern and speculation, among the participants, about secret assessment by the researcher was pointed out by Bryman (2008a).

It is important to mention that, in the observations, I used the first person because I felt this would give a more accurate picture of the research I undertook; and I acknowledge the importance of the role of the researcher in this qualitative in-depth case study.

4.4 Research approach

4.4.1 Introduction

According to Strauss and Corbin (1990), qualitative research may be described as a type of research which produces results that are not achieved using measurable techniques and statistical processes. Under a quantitative research, the researcher embarks on determining the general causes and predicting results whereas in qualitative research, the aim of the researcher is to deliberate, and comprehend as well as analyse certain phenomena (Hoepfl, 1997). Quantitative research differs from qualitative research because it is mainly concerned with different varieties of knowledge (Hoepfl, 1997).

Qualitative study can be defined as a situational activity, which involves locating research activities around the globe (Denzin & Lincoln, 2005). It is comprised of interpretive and material activities, which explain several global phenomena. It is through such activities that the world is transformed. They are responsible for conversion of the globe into specific sequences that are comprised of interviews, discussions, field notes, recordings, personal memos and photographic images. In view of this, it may be imperative to infer that a qualitative study entails a naturalistic and interpretive approach of the world. This implies that researchers involved in a qualitative study examine things within their natural form by attempting to comprehend and explain the phenomenological meanings portrayed by the participants (Denzin & Lincoln, 2005).

A qualitative study offers a description that enables the research topic to be examined comprehensively, particularly using ethnic backgrounds, and interviews alongside the study of certain cases (Harwell, 2011). Within this approach, a description pertaining to the participant-researcher interactions in a natural setup containing few challenges tends to exist, thus leading to a research process that is convenient and transparent (Harwell, 2011). Such distinctive relations enable the researcher to come up with numerous outcomes from one participant; because both the researcher and the participant produce results under specific situations (Lincoln & Guba, 1985).

This research used qualitative methods for three reasons. As Shavelson and Towne (2002) suggest, qualitative studies may be utilized for the investigation of procedures, which are capable of producing descriptive data or solving the questions that entail - how, why and what. As a result, this approach helped me to answer my research questions, with which I want to investigate the barriers that teachers face when using technology, and why or why they did not overcome obstacles.

The second reason follows Maxwell (2005) argument that a qualitative study should be designed in a way that is adaptable with the conditions under which the study is being executed; the design should not be merely a fixed determining factor of research practice. Therefore, I benefited from this point, which appears when I change their line of questioning depending on the participant and his response, because some teachers used technology and other do not use it with their students, which made me change and add some questions helped me in finding the cogent answers to my research questions.

Inductive thinking has been used to imply reasoning "*from particular instances to general principles. One starts from observed data and develops a generalization which explains the relationship between the objects observed*" (Beveridge, 1950, p.113).

Thirdly, Johnson (1995) suggests that technology educators carry out research work aimed at reaching a greater understanding, rather than probing superficial aspects. He notes that qualitative methodologies are powerful tools for enhancing our understanding of teaching and learning, and that they have become increasingly adopted in recent years.

4.4.2 Strengths and Weaknesses in the qualitative method

Firstly, the diverse characteristics of a qualitative study that outline the comprehensive nature of the study are distinguished (Jabeen, 2013). They are comprised of a wide variety of epistemological positions that include interpretive, phenomenology, ethno-methodology, postmodern and relativist among others (Hess-Biber, & Leavy, 2004). Additionally, through the use of a many-branched tree analogy, Li Wolcott (Wolcott, 1992 cited in Putney, Green, Dixon, & Kelly, 1999) explored different techniques, for instance, observation, interview and archival were all utilized across various qualitative research perspectives as well as disciplines. This diversity allowed me to use different strategies from interviews to observations, which led me to a more comprehensive investigation of the barriers that teachers face when using technology in their classrooms in the Kingdom of Saudi Arabia, and why some overcame obstacles and why others did not.

Secondly, the efficiency inherent in qualitative techniques relies largely on accurate data, because of the kind of correlation that exists between the subject and the researcher, coupled with different tools utilized for collecting data alongside the ontological position of the researcher that enables him or her to have a better understanding of the facts (Jabeen, 2013). The techniques used in qualitative studies, for example, to create relations and trust, probe responses and follow up questions (Baker, 1996) provide researchers with the means of coping with certain scenarios. Such scenarios include when participants fail to interpret the question, cannot remember or come up with an answer, are influenced by phobia and stigma and omit or give false information (Baker, 1996; Hines, 1993). During the research with six mathematics teachers, I came across a number of similar situations. For instance, some of those teachers were reluctant to talk about the main reasons why they were not using technology with their students. But my relationship with the teachers over the long periods of observation and in-depth interviews made me confident about the accuracy of data.

Thirdly, the methods used in qualitative studies have a rich narrative as well as description, thus instead of offering results, they concentrate on discussing the procedure (Velez, 2008). Quantitative inquiry fails to come up with an initial understanding of the context under which the interaction of the human beings being examined takes place; this contradicts the goals of qualitative inquiry (Velez, 2008). Although quantitative data may be used for describing numerical data, its description is limited to the surface, unlike in qualitative investigation which is characterized by an in-depth understanding of the phenomenon that is under observation and discovering its meaning via a comprehensive explanation that is non-existent in quantitative research (Filstead, 1979).

In spite of the strong attributes associated with the techniques of qualitative research (Golafshani, 2003; Groth, 2010), it would be imperative for researchers to understand the setbacks that are inherent in such techniques so that plans are initiated to attempt to reduce the consequences emanating from the limitations (Sharma, 2013). Anfara, Brown, & Mangione (2002) suggest that qualitative investigations are quite often examined against a positivist criterion that includes validity as well as reliability and they are found to lack certain or all the criteria.

Lankshear & Knobel (2004) came up with two separate techniques that demonstrate the reliability of qualitative study. The traditional technique entails trying to indicate that qualitative researches may fulfill the quality control criteria upon which quantitative researches are commonly held. The second approach that introduced lately entails using a separate set of unique criteria (Golafshani, 2003; Morse, Barrett, Mayan, Olson, & Spiers, 2002; Simon, 2004).

The traditionalist model of analyzing qualitative studies is commonly linked to positivism (Cobb, 2007; Ernest, 1997; Kalinowski, Lai, Fidler, & Cumming, 2010). Qualitative researchers who are deeply entrenched in positivism aim to show that the standards of various kinds of reliability, generalizability and validity by which quantitative research is measured are fulfilled (Groth, 2010). There are guidebooks that provide suggestions on ways of adapting the requirements for quality control to be used in qualitative research (Cresswell, 2008; Kalinowski et al,. 2010; Miles & Huberman, 1994; Morse et al., 2002).

The second technique of assessing qualitative research discards positivistic criteria for being overly restrictive and simplistic (Sharma, 2013). According to Battista et al. (2009) and Lesh (2002), qualitative research may not be measured using a similar criterion as quantitative techniques. Lesh observes that off-the-shelf explanations, for instance, reliability and validity, which were previously relevant, cannot be relied upon in modern research of mathematics teaching. As suggested by Lesh (2002), it makes sense to utilize closely linked criteria that include share ability, meaningfulness and usefulness. The people who embrace the latest technique often argue that traditionalist standards of evaluating quantitative studies are redundant for qualitative studies because their nature of evolution is fluid. Elliott, Fischer, &Rennie (1999) recommended seven guidelines of qualitative studies. Because both the aforementioned techniques of evaluating qualitative studies depend on various ontological assumptions, it may be impossible to locate an accepted universal framework of dealing with the claims that qualitative studies are inherently inferior compared to quantitative studies (Groth, 2010). Notably, some techniques of evaluation bear reflections of positivist assumptions while others do not (Groth, 2010). Characteristics of both techniques which offer authentic checks within qualitative research are discussed below.

Reliability refers to the activity of measuring consistency on time as well as on similar samples, the duration under which a process yields similar outcomes under constant conditions on various occasions with one person or it may involve several interviewers (Cohen et al., 2007). A question that elicits one kind of answer on a single occasion but on another produces a separate response is termed as unreliable (Sharma, 2010). Cohen, Manion, & Morrison (2000) observes that qualitative researchers have a tendency to perceive reliability as the link between the information they record and the events that take place within the natural environment instead of as accurate measurements involving various observations.

As Burns (2000) suggests, reliability within qualitative research may be achieved when researchers state the objectives of the research coupled with the key question that should be addressed, they explore their perspectives over the question, outlining their assumptions along with biases in the research, explain the processes of collecting data and the groups that have been created for analysis. However, Anfara et al. (2002) suggests that inclusion of information on decisions which are made in the procedure of developing qualitative studies is one way of answering the question that pertains to whether the results are authentic and reliable or not. They provide three proposals for evaluating the rigors of methodology as well as analytical defensibility for qualitative paradigms: developing interview questions, which address the research questions, analyzing data using code maps and authentication of findings as well as data triangulation. Triangulation plays a critical role in helping to explain that the phenomena which were observed were not a mere product from the instrument and technique utilized within the research. Triangulation exists if two or multiple techniques of collecting data and data sources are utilized to bring out a clear phenomenological picture that is being examined (Cohen, Manion, & Morrison, 2011; Patton, 2002).

Validity is an aspect that is related closely with the concept of reliability. Just as reliability, it mainly deals with errors which can occur during the study process (Sharma, 2010). It is specifically concerned with the notion of whether an instrument can measure or describe the concept that is required to be measured or described (Bell, 1993). McCormick & James (1988) note that because researchers involved in qualitative studies attempt to understand their participants' experiences within naturalistic setups, they tend to assume that such techniques are closer to accuracy and thus, have more validity or have an iota of ecologic validity (that is being valid within a specified group or site).

According to Patton (2002), validity within the techniques of qualitative studies relies largely on the researcher's rigorous competence and skill. For example, limitations to validity during interviews may be overcome by reducing the quantity of wrong interpretations by asking participants whether the inferences provided are factual (Sharma, 2013). Hunting (1983) provides steps of increasing the relevance of the content alongside the representative nature of the chosen activities. He observes that the validity of the content may be achieved through evaluation of the recommended activities based on the content that is regarded as relevant across different age groups in key curriculum papers.

Generalizability is a term used by researchers to determine if the study findings transcend the setting and people being examined (Bell, 1993; Burns, 2000). People opposed to qualitative research suggest that one critical benefit of a comprehensive qualitative research is that generalizability cannot be achieved beyond the sample that is under examination (Sharma, 2010). Various types of qualitative studies share the perception that aspects of validity as well as generalizability are created using mechanisms that are different from the traditionalist criteria that are utilized in reference to transferring and applying findings from a single setting towards another (Sharma, 2010). The purpose of qualitative studies is not to generalize the findings, but rather to provide an understanding of the specified situation. The emphasis is placed on local setup and unique context at the expense of generalizing the results (Sharma, 2010). As suggested by Bell (1993), researchers interested in the generalizability issue could benefit from other research studies in order to ascertain how representative what they discovered; or else, they perform a big number of mini-studies with a lower level of intensity. Many researchers outline the significance of making teaching and learning activities open for reviewing the entire community (Drew, Hardman, & Hosp, 2008; Groth, 2010; Watson, 2002). Availing tasks for public assessment enables the researcher to improve the practice and boost the possibility of the task becoming beneficial to various mathematics teachers (Sharma, 2010).

Kalinowski et al. (2010) observes that whichever process of data collection is chosen, it ought to be analyzed critically to determine the extent under which it can considered as reliable and valid. In my study I tried to address these issues to achieve the greatest possible degree of validity and reliability. Starting with the validity through the presentation of my interview questions to the Department of Education, University of Durham, presenting the questions in its primary stages to the supervisor for discussions with him. Before the researcher applied to the School of Education Ethics Committee at Durham University, which assessed the ethical integrity of my research, the researcher put the questions for evaluating it by a committee of referees in all aspects: language, clarity and contradiction. These were submitted to the panelists in two versions, Arabic and English (see Appendices six and eight). In this way, it can be seen that these steps helped to validate the research, which there was approval, whilst some comments and recommendations were followed up by appropriate modifications. To enhance reliability and minimize interviewer bias, the study employed a semi-structured approach. Each teacher interviewed was initially assigned an identical task. During the interview, care was taken to avoid leading the teachers towards any particular viewpoint, so responses to questions were accepted as they were given and probing questions were asked simply to ascertain the reasons for what the teacher thought. Additionally, in some cases, teachers were asked to comment on the transcripts to ensure that the meaning constructed by me was the same as that constructed by the teachers. Moreover, the researcher collected the interview data by interacting face-to-face with the participants and physically observing their actions in their classrooms. As the research was with mathematics teachers, the researcher endeavored to create mutual understanding and a healthy relationship in my daily interactions with the participants. As the researcher integrated with the participants, the power relationship was flattened, and the "researcher" became one of the participants, which gave my finding power of validity and reliability.

Thematic analysis (Braun & Clarke, 2006) was used to analyze the interview data in my study, and to ascertain its validity and reliability, the researcher listened to the audiotapes in an active way, transcribing and translating (in some cases) data, reading and re-reading the data set.

Data from classroom observations were used to check initial findings, and to fill gaps. Obtaining data from the interviews and classroom observations helped me to fully answer my research questions with greater accuracy.

I acknowledge that the findings of my study may not be general to all settings because teachers in other areas and countries are likely to have very different experiences and hence their reasoning would differ. However, the goal of most qualitative studies is not to generalize but rather to provide a rich, contextualized understanding of some aspects of human experience through the intensive study of particular cases.

It is important before closing this section to mention also how the researcher promotes dependability and confirmability of this study. As suggested by Bitsch (2005), dependability means the results remaining stable during a period of time. Involved in dependability are aspects that include assessment of the results of the participants and interpretation, as well as the research study’s recommendations, including those corroborated by data collected from the participants (Cohen et al., 2011). To increase dependability in this study, the researcher decided to utilise an investigation audit trial

(Baxter & Eyles, 1997; Bryman, 2008b; Guba, 1981). In the audit trail, the investigation procedure and product are examined for data authentication purposes, a step through which the researcher explains all research-related decisions and activities in order to elucidate the modus operandi of gathering, recording and analysing the data (Bowen, 2009; Li, 2004). Also, through the audit trail the research study's confirmability is established (Lincoln & Guba, 1985; Tobin & Begley, 2004). What is meant by confirmability is how far the investigation's findings could be confirmed or supported by other researchers (Baxter & Eyles, 1997). Confirmability is essentially about ensuring that data as well as the interpretations of the results are not merely something created by the researcher's mind, but rather evidently based on the data (Tobin & Begley, 2004). To promote confirmability in this study, the researcher decided to utilise a tape-recorder with the purpose of achieving higher data precision. Furthermore, in the course of my translation and transcription of the data of the interviews, I did all I could to ensure the transcriptions and translations were as faithful as possible to the original recordings.

To sum up, qualitative research is particularly useful for the in-depth study of a small group of people. Despite the strengths attributed to qualitative research approaches, it has been criticized for lack of reliability, validity and generalizability. It is important that researchers be aware of the limitations associated with these methods so that measures are put in place to try and minimize the effects of these limitations, which the researcher tried to enhance the reliability, validity, dependability and confirmability of the qualitative research methods.

4.4.3 Case study methodology

As suggested by Sturman (1997), a case study is a term that is broadly used in relation to the investigation of a person, a group of individuals or phenomenon. In the view of Gomm, Hammersley, and Foster (2000), the term of case study is related to research work that is aimed at probing a small number of cases in great depth. Case studies can be divided into different categories. Yin (1984) identifies them as explanatory, descriptive and exploratory. Firstly, exploratory case studies aim at exploring any phenomenon within the data that acts as the researcher's focal point (Zainal, 2007). For instance, as a researcher conducting an exploratory case study on teacher use of technology, I asked general questions, such as, "Do you use technology in your classroom to help students with mathematics difficulties?" and “If so, why did you decide to use technology? If not, why do you not use technology?” The purpose of these general questions is to create an opportunity for the phenomenon monitored to be further investigated.

Secondly, descriptive case studies embark on coming up with a description of the natural phenomenon that is inherent in the concerned data (Zainal, 2007), for instance, “did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe. If not, how did you overcome the problem of training?” The objective that the researcher identified entailed coming up with a description of the information as it emerges. McDonough and McDonough (1997) observe that descriptive studies exist in the form of a narrative. Thirdly, explanatory case studies are characterized by a closer examination of the information from the surface through to the deep end to provide an explanation of the phenomena that exists within the data (Zainal, 2007). For instance, “why did you decide to use/not use technology for this lesson with students who have mathematics difficulties?”

The aforementioned case study categories namely explanatory, descriptive and exploratory were utilized in the current research for answering research questions because the case studies are suitable techniques for conducting a deep and holistic examination (Feagin, Orum, & Sjoberg, 1991). Therefore, Yin (1984) warns researchers against attempting to separate the three categories or arrange them hierarchically. Yin (1984) observes that one notable misconception revolves around the arrangement of different techniques of research in a hierarchical manner. Therefore, researchers were previously made to believe that case studies were essential during the exploratory stage of a research, that surveys and histories suited the descriptive stage (Tellis, 1997a). Additionally, we were made to believe that the experiments were the only means in which exploratory (causal) investigations could be conducted (Tellis, 1997a).

Because of this, the comprehensive qualitative information commonly produced within case studies may be used for exploring or describing the information in real-life scenarios. Furthermore, they may help in explaining the complex nature of real-life environments that cannot be obtained using experiments alongside survey studies, thus adding a benefit to the application of qualitative studies (Dube, Makura, & David, 2013).

The case study approach was chosen in this study, given that it would help the researcher develop an in-depth understanding, as well as enable a particular phenomenon to be examined within a certain environment, where a particular aspect is concentrated on (Yin, 2009). As suggested by Creswell (2007), with the utilisation of this technique the researcher is able to examine a bounded system, which is done through the gathering of in-depth data from a variety of sources. Additionally, as described by Yin (1994) the technique of case study is appropriate to handle the two questions of how' and 'why', which not have tackled enough by other research strategies. Furthermore, I used this method because, as indicated by Gummesson (1988), one advantage of the utilisation of a case study in research work is related to the all-encompassing nature with which the process is encircled. Typically, case studies involve this kind of all-encompassing information which is vital to assisting the investigation and depiction of the information in a real-world situation, as well as to aiding the illustration of the intricate nature around real-world scenarios, which cannot be otherwise achieved in the event of a different technique being employed (Velez, 2008). For instance, this method gave me access to not only the numerical information concerning the use of technology, but also the reasons for the use or misuse of technology, and how the technology is used in classrooms.

Although they have their merits, case studies have been the target of critical opinions. Yin (1984) provided a discussion of three lines of argument against the research work based on case study. The first is the frequent accusation of case studies over the absence of rigour. As suggested by Yin (1984) "*too many times, the case study investigator has been sloppy, and has allowed equivocal evidence or biased views to influence the direction of the findings and conclusions*" (p. 21). The second line of argument is that, given the fact that they employ a few subjects, sometimes only one subject, case studies offer only an extremely limited ground for scientific generalisation. One of the frequent criticisms levelled against the technique of case study is the fact that it relies on a single case investigation, whereby a generalised result is hard to achieve (Tellis, 1997b). Given the small number of sampling cases, Yin (1993) regarded case methodology as 'microscopic'. Nonetheless, as viewed by Hamel, Dufour, and Fortin, (1993) and Yin (1994), the designation of the parameter and the setting of the objective of the research study are of far greater significance in case study-based technique than in the case of a big-size sample. As per the third line of argument, frequently case studies are described as being quite long and hard to carry out, let alone their creation of a huge quantity of documentation (Yin, 1984).

It is also interesting before closing this section to explain the reason for using the interview and observation methods to collect my data, which because Frey and Fontana (1991) observed that the focus of case studies is on two kinds of collecting data: interviews and observation. Under observation, a researcher performs several functions, for instance observing the participant, watching as well as listening to the unfolding events and the interaction of members within a given setting. In interviews, the researcher poses probing and directed questions, which are a reflection of the observation as well as the theoretical orientation that was initiated earlier (Frey & Fontana, 1991).

4.5 Data Collection Methods

The selection involving the research method is largely influenced by the theoretical perspective of the researcher along with the perception he embraces towards the manner in which data would be utilized (Gray, 2004). Additionally, it should provide an explanation of the rationale that led to the choice of the techniques that were utilized (Crotty, 1998). The research aims to investigate the obstacles of using technology in primary schools to help students who have mathematics difficulties in the Kingdom of Saudi Arabia. Therefore, the researcher chose interviewing and observation as techniques for the purpose of this research and as Ryan (2006) mentioned, in qualitative research, interviews and observations often are used to collect data. Moreover, data collected through interviews and observations can be compared. Observations are crucial to see the effects of technology on the students' mathematical learning. However, observation may not be enough. As the researcher want to investigate the barriers that teachers face when using technology and why they overcame obstacles or why not, face-to-face interviews were probably the best approach to answer these questions.

4.5.1 Semi-structured interviews

Cannell and Kahn (1968) described a research interview as a conversation that is comprised of two people whereby the interviewer plays the role of an initiator with the main objective of collecting appropriate research data. Notably, the focus of the content is outlined through the research goals of systematic explanation, prediction and description emanates from the initiator of the interview. In qualitative studies, interviewing emerges as a critical source for qualitative data that enhances understanding of the phenomena being examined (Drew et al., 2008; Fontana & Frey, 2005). Interviews offer a researcher the opportunity of investigating participants' ideas alongside beliefs and gathering information that could not be collected using other techniques, for instance, observation (Cohen et al., 2000; Shaughnessy, 2007).

There were a number of advantages to using the personal interview as the method of data collection. It is capable of overcoming the poor responses in questionnaire surveys (Noyes & Baber, 1999); it is also suitable for exploring perceptions, motives, beliefs and values (Richardson, Dohrenwend, & Klein, 1965; Smith, 1975). It creates an avenue of evaluating the authenticity of the answers from the participant through observation of silent (non-verbal) indicators (Gordon, 1975); it is capable of facilitating comparability by making sure that each participant supplies answers to all questions (Bailey, 1987); it prevents the participant from seeking assistance from fellow participants while developing a response (Bailey, 1987).

Depending on the purpose of the interview, interviews can be divided into three types: structured, unstructured, and semi-structured (Fontana & Frey, 2005). Furthermore, when the researcher is acquainted with knowledge concerning the exploratory and confirmatory kinds of study, he or she can determine the structure for the questions to be used in the interview (Sharma, 2010). Critical aspects within interviews entail maintenance of a calm posture, asking understandable questions, taking notes, appropriately using follow-up questions or prompts, and creating trust, along with tracking responses (Cohen et al., 2000; Drew et al., 2008).

The most widely used interviewing technique is the semi-structured interview (Mason, 2004). Semi-structured interviews are characterized by a flexible as well as fluid structure (Adamson, 2006), compared with structured interviews that have a structured series of questions that would be posed to all interviewees using one format (Mason, 2004). The layout for a semi-structured interview is normally organized around an interview guide. This is comprised of topics, thematic concerns or areas that would be covered in the interviewing process, instead of a series containing standardized questions. The purpose entails ensuring there is flexibility in the ways in which coupled with the type of sequential questions asked; and the manner in which specific areas could be tracked and nurtured with separate interviewees. This is mainly done to enable the interview to be designed by the personal understandings of the interviewee and the interests of the researcher. In unstructured interviews, there is no predetermination of questions; the conversation depends on the spontaneity of generating content as well as context. Because of this, each participant is asked separate sequential questions. Notably, this technique is not as reliable and precise as the structured interview. This interviewing technique is also known as non-directive interview (Mason, 2004).

In this study, the researcher used a semi-structured interview for three reasons. First, this technique provides a flexible method for small-scale studies (Drever, 1995). My study involved obtaining information from only six teachers, it was considered appropriate to use semi-structured interviews in the case of teachers. Indeed, this technique tends to offer useful information when the size of the sample is not big. Additionally, it enables themes in the qualitative data to be analyzed (Alvarez & Urla, 2002).

Secondly, as the researcher want to investigate the barriers that teachers face when using technology, and why they overcame obstacles or why they did not. In ascertaining the effectiveness of semi-structured interviewing to answer my research questions, I referred to Cohen & Manion (1994) and Nunan (1992), who consider the semi-structured interview as a preferred option for researchers intending to interpret the interviewees' responses. Moreover, the technique provided a suitable avenue for understanding the emotions, experiences and thoughts of the participants (Adamson, 2006). It enabled participants to convey their interpretations of the experiences that relate to technological application as well as cases where it is not used. The semi-structured interviews could be considered as an attempt aimed at discovering personal interpretations and meanings of participants. The semi-structured interview technique produces a constructive interaction between the participant and the researcher, has few limitations and is capable of empowering the people involved to form their personal interpretations as well as meanings (Cohen & Crabtree, 2006). The researcher certainly felt privileged during the interviews with these mathematics teachers, who spoke very openly and honestly about their experiences as they described the challenges they faced.

Third, the design of the interviews was based on predetermined subjects; the interview questions were prepared before the interview. However, semi-structured features of the interviews led to the emergence of new questions from the responses of the interviewees (Zhang & Wildemuth, 2009). Therefore, the researcher was successful in examining the concerns that emanated from participants; instead of strictly following the set questions that existed within structured interviews (Minichiello, Aroni, Timewell, & Alexander, 1995). More detailed questions were asked after the general ones, first those related to what the interviewee said and then the next questions on the list that allowed the interviewees to influence the content of the interviews within the general framework proposed by the researcher and, prioritizes their perspectives on the problems raised. The interviewees might have an influence on the order, and the redesign as well as interpretation of questions used in the interview coupled with choosing their own responses and clarifying the contextual meaning (Smaling, 1996).

4.5.1.1 Establishing Contact

To enhance a smooth interview process, the researcher ensured that a secure and good environment with enough space, the necessary facilities, for instance, a tape recorder and batteries were in order prior to the day of the interview. Moreover, establishing contact is important for the interviewee.

The contact was established with the first interview. I re-introduced myself; verbally reviewed the research objectives and read through the consent form to enable the participant verify his willingness to take part in interview.

4.5.1.2 Interviews procedure

The first step in constructing the interview questions was to divide the main study questions into two parts. The first part contained general information about the use of technology, which consisted of eight questions. The first question was designed to understand why some mathematics teachers decide to use technology to help students with mathematics difficulties or why others do not use technology? The second question is about the types of technology that mathematics teachers use with those students.

The third and fourth questions focused on teachers' opinions about using technology in mathematics teaching, and asked about: 3) Does the technology help you cover the key mathematics concepts in the syllabus? 4) Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?

The fifth question was about their potential to learn anything new by using technology in their class to ensure that they have information about the use of technology complete and updated.

The sixth and seventh were designed to investigate the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of three parts, which included training teachers to use technology, technical support, teacher attitudes and beliefs about teaching mathematics with technology. In these questions, teachers were encouraged to apply technology in schools in order to help students with mathematics difficulties, by showing them obstacles and how technology barriers can be overcome. Finally, the researcher asked them about any support they needed to facilitate their use of technology.

The second part contained specific information about the use of technology, which consisted of ten questions were as follows:

- Why did you decide to use or not use technology for this lesson with students who have mathematics difficulties?
- Is technology used to increase basic skills, to make the understanding of complex mathematical operations easier or as a resource to entertain students?
- How often do you use technology when teaching students with mathematics difficulties?
- Where do you usually get your ideas from for using technology? (Magazines, colleagues, workshops, technology coordinator, and internet or somewhere else)
- Did your college education include any learning activities on how to use technology for teaching those students?

  If yes, please describe

  If not, how did you overcome the problem of training?
- If offered, how likely would you be to participate in technology training either during or after school time?

  If no, what factors may have led you not to attend training sessions.
- What is needed to make the necessary teacher training work?

- If you wanted a technical support in your class but it is not available in the school right now, how would you overcome this problem?
- How can we overcome the negative attitude of teachers towards the use of technology?

4.5.1.3 Translation of the interviewed questions

The interview questions were written in English and later translated to Arabic, a process that was followed by another translation from a different person to ensure accuracy. The procedure was conducted via several stages. Firstly, after the supervisor approved it, the researcher embarked on the translation process, afterwards a translator who specializes in Arabic and English translation was consulted to produce two separate versions including mine, which were later integrated to create a single version that had to be closer to the initial meaning. In the entire process, there were instances where a specialist was required to ensure accuracy during translation and for clarification of what the researcher meant.

4.5.1.4 Interview Schedule

The interview schedule enhance proper utilization of the interview time by enabling the researcher to interview participants on various topics in a systematic and comprehensive manner; coupled with helping to maintain the focus of interactions (Hoepfl, 1997). Thus, a 35-45 minute interview was planned for each respondent; each interview session was recorded with the consent of each participant. The respondent selected the venue of the interview alongside a convenient time to prevent any effect on their responses or cooperation that would influence the interview (Breakwell, 1990).

In line with the flexible designs of qualitative research, interview guides may be adjusted to shift the attention towards critical areas, or to dismiss the questions, which, in the researcher's view, are not helpful for the research's goals (Lofland & Lofland, 1984). For two out of the three instructors who utilized technology with their learners, the duration of the interview was about 45 minutes.

4.5.1.5 Pilot interviews

Pilot interviews were conducted to determine the relevance surrounding the interview questions, coupled with the duration of the interview as well as for evaluation of the researcher's ability to perform the task. The interview rehearsal was undertaken by two experienced teachers, one who utilized technology in the classroom, whereas the other did not. Furthermore, the two teachers did not participate in the main sample. This implies that they did not represent schools A and B. The participants in the interview were briefed on the interview objectives and encouraged to give their views freely. Afterwards, the main sample involved 6 mathematics instructors who were picked from schools A as well as school B.

4.5.2 Observation

Observation is a "*distinct feature of the research process that offers an investigator the opportunity to collect life data from naturally occurring situations*" (Cohen et al., 2007, p.396). Observations help the researcher in explaining the situations that exist using the five senses as well as creating a "written photograph" for the phenomena being examined (Erlandson, Harris, Skipper, & Allen, 1993).

In the current research, direct observation was utilized. Under this kind of research, the researcher observes and hears the unfolding phenomena directly. The observation may be guided using a group of questions which a researcher is attempting to answer (Thomas, 2003). Indeed, embarking on fieldwork with the intent of collecting data using other sources, for instance interviews, provides an avenue of making direct observation (Yin, 2003). For the reasons behind the use of this technique, I referred to Patton (2002) who identified various benefits of utilizing the direct observation approach. The method helps the researcher to; have an understanding of the setup within which the interaction of people takes place. Additionally, it enables the researcher to observe and uncover things, which people within the region have not noticed; and identify things, which people would be unwilling to discuss during an interview, that is a critical issue; transcend the selective opinions of people; being transparent, inductive and innovation-oriented to assist the researcher obtain wide experience concerning the phenomena. In addition, Thomas (2003) suggested that observing things directly has the benefit of obtaining data from natural and coincidental events.

However, it should be noted that through the direct observation technique, certain challenges such as falsification of information because the behavior of people is likely to change if they discover that they are under observation; there is limited data from the things that are under observation within a setup (Patton, 2002). Notably, the observation solely places emphasis on external habits because the researcher is not able to discern the emotions and perceptions of the people (Patton, 2002).

In fact, with the help of the interview method, the researcher was to adopt a thoroughly explanatory direct observation technique as a foundation for the evidential data gathered for the current study. In respect to the participants, all mathematics teachers interviewed were asked to allow me to observe them in the classrooms, which gave the researcher a better understanding of the information gathered through the interviews. This means observation is a good way of crosschecking people's answers to questions. Its use may also generate questions for further investigation and help form future discussions or frame questions in case of inconsistencies between what the interviewer of a key informant observes and what the respondents are saying. Furthermore, the researcher was able, owing to the method of direct observation, to identify some of the matters examined naturally and without planning.

4.5.2.1 Observation Sample

There was an agreement between the supervisor and the researcher over the need to conduct an observation on six mathematics teachers alongside their students (fourth, fifth and sixth grades within school A as well as B), it is noteworthy that those teachers themselves who were interviewed before.

As mentioned in the literature of research methodology, it is not easy within the qualitative technique to select a huge sample, particularly with the observation tools; thus, the process of observing six instructors in various schools was successful.

4.5.2.2 Conducting the Observation

As we know that classrooms offer a suitable environment where various learning as well as teaching processes can take place. In this context, thinking about the aspects that should be monitored and the way in which the monitoring should be done is a highly pertinent step (Wajnryb, 1992). As a result, in this session, the researcher explained what and how he had observed the teacher to give a clear picture about the main reason for using this method in this study.

In order to compare the teaching and learning through use of technology and without technology. Classroom visits were undertaken in three classrooms in school A that used technology with their students by the researcher to observe what and how technology was being used by teachers in mathematics education with those students who have difficulties, and whether they were being used to facilitate interactive, collaborative learning. In addition, what lessons do introduce by technology; and in another three classrooms in school B without technology to observe how the classrooms did without using technology.

The observations that took place within three classrooms in school A were based on the set of questions indicated below and these questions were answered over a period of six weeks:

- The lessons where the mathematics teacher tried to use technology?
- What type of technology was used to assist those students?
- In which way do mathematics instructors utilize technology within their classroom?
- What impact emanated from the use of technology on learners with mathematics problems?
- Were there any challenges in using the technological instruments?
- Others

While another three classrooms that do not use technology with those students who have difficulties in mathematics in school B were guided by the following questions, which were answered over a six weeks period:

- How does lack of technology use within the classroom impact:
  Use of time in class? How learners acquire knowledge? Teacher attainment of objectives for the lesson? The interaction of learners in this lesson?
- Does the lack of technology have a negative or positive impact on learners during the mathematics lessons?
- What are the impacts of the lack of technology on the current teaching method?
- Others

The above observation list was checked by the supervisor of this study. Some words were changed to make the meaning clearer or to reach the answer to the research questions.

Observing six classrooms generally provides unlimited view of the classrooms situation because it shows three aspects of a much larger picture in both schools separately. At the initial teachers' meeting, I was careful to acquaint them with the observations' aim, by explaining that there would not be an evaluation of their methods. The teachers' names, the students' grades and the lesson title were included in the field notes of the observational process. I would enter the teacher's study 10 minutes before the commencement of the class to enquire of the teacher details of the lesson and the tasks that he intended to utilise with this class. At the initial class observation, the teacher introduced me to all the students.

In order to observe both the teacher and all the students, I would position myself at the back of the classroom in the corner. I make notes continuously throughout the lesson and for each participant I observed 45 classes. Following some observations in the classroom, I requested that each teacher organises a second interview. I indicated to every participant that the subject of the initial interview would be general enquiries regarding the utilisation of technology (Part 1). I also indicated that the second interview would be concerned with particular enquiries regarding the research questions (Part 2). It is significant to state the teachers two and four expressed a preference for the two interviews to be conducted on the same day. However, I told them that I consider it important that I observe them between the two interviews, a suggestion to which they agreed.

4.6 The sample

4.6.1 Sample Size

The size of the sample is described by Larson-Hall (2010) as the main participants taking part within the experiment. It is common knowledge that the larger the sample the better the findings that in turn increases the results validity as well as the likelihood of making them general for the entire population (Gay & Airasian, 2003; Cohen et al., 2007; Bryman, 2008b). However, Crowl (1996) observes that it may not be necessary to get a huge sample, thus suggests that caution should be practiced when selecting the samples. Crowl (1996) and Bryman (2008b) argue is important to get high response levels from smaller sized samples compared to low response levels from larger sized samples. At same time, Bryman (2008b) emphasizes the significance of validity within the research design rather than from the sample. Because of this, the researcher opted for a smaller sample as suggested by Crowl (1996) and Bryman (2008b), whereby six mathematics teachers with various academic backgrounds participated in the study; some of these teachers use technology with their students and some of them do not use it with their students.

In general, samples meant for use in qualitative research are usually small compared to those utilized in quantitative research (Mason, 2010). Ritchie, Lewis, and Elam (2003) have explanations for this. An aspect of diminishing returns towards a qualitative sample as the research continues, more information does not emanate from more data. This can be attributed to the fact that the existence of a single set of data as well as code is what is required to integrate it into the analytical framework. Frequencies are not important in qualitative studies, because the existence of one set of data is highly beneficial as several in the understanding of the procedure behind a subject. This is partly because qualitative studies are more concerned with the meaning and not generalization of the hypothesis statements (Crouch & McKenzie, 2006). Lastly, given that qualitative research requires an extremely large amount of labour, analysing a big sample may consume a lot of time and is impractical (Mason, 2010).

In any research site, several participants may have different views (Mason, 2010). Qualitative samples should be huge enough to ensure that all critical attitudes are unearthed, however on the same issue, it should be noted that when size of the sample is enormous, the information becomes repetitive thus redundant (Mason, 2010). When the researcher sticks to the requirements of qualitative studies, the size of the sample within the large portion of qualitative research should follow the saturation concept (for instance, Glaser & Strauss, 1967) if gathering of additional data fails to offer more explanation over the phenomena under investigation (Mason, 2010).

4.6.2 Sampling Procedures

I commenced the selection procedure by writing to six primary schools to ask if they were prepared to participate. The letter included an introductory letter and consent form that was requested be sent back to me to indicate willingness to participate. I selected these particular schools in Saudi Arabia because I know the area well, thus making it easier to efficiently direct my project to the schools I was interested in. Additionally, some of the students in the selected schools experience learning difficulties in mathematics. I also considered the fact the some of these schools utilise technology while others do not.

It is significant to indicate that neither the class teachers nor the head teachers in these schools were previously known to me. In fact, I did not know what was the opinion of the head teachers with regard to technology. I chose the first two schools that returned the letter to me to be part of my research since I was subject to time restrictions. I was fortunate to discover that School A makes use of technology and that each of three teachers of mathematics utilise technology to assist the students. However, School B does not utilise technology. I consider that my selection of various schools may have altered what I discovered in the research. This is because I accept the my research results may not necessarily be universal to every school in Saudi since other schools may well have similar or varying experiences and therefore they would have a different thought process.

The approach for participant selection was to choose teachers using criterion sampling. Criterion sampling involves selecting samples that meet particular criteria. In this case, the criterion was to select teachers who had experience using technology for helping those students who have mathematics teachers. Fortunately, the researcher found all three mathematics teachers in school A have different experiences with using technology. However, discussions with the school administrators and teachers determined this selection criterion to be unnecessary since, in school A, teachers were required to use either technology or not use technology, because if the researcher found all three teachers in school A did not use technology I can find this the criterion in school B.

Six mathematics teachers with various academic backgrounds were participating in this study, all of them had between five and twenty six years' experience in teaching mathematics. Three of these teachers in school A use technology with their students who have mathematics difficulties and another three teachers in school B do not use it with their students. Since both of these schools have only three teachers of mathematics, I consider that if I had the opportunity to select six other teachers, instead of the current participants, the results would not be affected. Since all six participating teachers accepted that the principals of school played a crucial role in managing the challenges they faced with IWB.

Teachers at each school became acquainted with the study in different ways. At school A, the teachers were not informed about the aim of this study by the researcher, because the first meeting to which the researcher was invited to describe the research for all three mathematics teachers was cancelled and no follow-up opportunity was available. As a result, the school administrator was the person that described the aim of this research to these teachers. However, at the beginning of interviewing these teachers, the researcher again explained to them the purpose of this study. At school B, the school administrator had informed to the mathematics teachers that a researcher would be conducting a study at the school. As a result, the researcher was invited to hold a meeting with these teachers and was given a few minutes to give a brief introduction of the study to the teachers.

4.7 Data Analysis

This section describes in detail the type of analysis method I used in this study, the reasons for choosing it and how data was analyzed.

Data analysis refers to the methodical pursuit of meaning. It is a means of processing qualitative data whereby the knowledge acquired can be transferred to others. Analysis refers to organisation and interrogation of data in a manner which enables researchers to examine trends, recognise themes, uncover relationships, create explanations, interpret, and mount critiques as well as produce theories. It usually entails identification of patterns, comparing, hypothesizing, classification, interpretation, evaluation and synthesis. It entails what H.F. Wolcott refers to as “mind-work”, because researchers use their intellectual abilities to understand the meaning for qualitative data (Hatch, 2002).

Qualitative analysis strategies are placed into three major groups: categorizing strategies (that include coding as well as thematic analysis), connecting strategies (they include narrative analysis as well as individual case studies) alongside memos as well as displays (Coffey & Atkinson, 1996; Dey, 1993; Maxwell, 2005).

Thematic analysis refers to the technique used to identify, analyse and report themes in data (Braun & Clarke, 2006). It plays an important role in organizing and describing a set of data comprehensively. Additionally, it interprets different characteristics for the topic used in the research (Boyatzis, 1998).

In this study, the researcher used thematic Analysis for four reasons. Firstly, a reliable qualitative study should have the capacity of drawing interpretations that are in line with the collected data (Alhojailan, 2012). In view of this, thematic analysis can determine and locate, for instance, aspects or variables, which influence issues produced by the respondents (Alhojailan, 2012). Thus, the interpretations of participants play a significant role in giving reliable explanations about their thoughts, actions and behaviors. This combines well with characteristics, which are involved during the thematic analysis procedure (Hatch, 2002; Creswell, 2003).

Secondly, one significance of this study is to encourage technology use in the schools of the Kingdom of Saudi Arabia to help teachers to help pupils who have difficulties in mathematics so that desired outcomes may be achieved and their abilities may be advanced. Therefore, the researcher observed the differences and similarities that take place between the using technology and without using technology. With this in mind, thematic Analysis emerges as a suitable method for dealing with this kind of information because it enables the researcher to outline the variations alongside the similarities that exist in a set of data (Creswell, 2009; Boyatzis, 1998).

Third, thematic Analysis offers the opportunity of coding and categorizing information into themes (Alhojailan, 2012). As pertains to the thematic analysis, the data that has been processed may be displayed as well as grouped based on their similarities and variations (Miles & Huberman, 1994). This may be achieved if the process includes noting patterns, classification and coding (Braun & Clarke, 2006), additionally, to produce a correlation between certain variables along with factors to come up with a sensible and systematic link of evidence (Creswell, 2009; Braun & Clarke, 2006; Miles & Huberman, 1994). Through collection of data with various techniques for instance, observation and interviews in one study alongside respondents in several situations, thematic analysis can yield effective data that reflects the real process of gathering data (Miles & Huberman, 1994; Creswell, 2009; Hayes, 1997).

Fourthly, in order to address the gaps in the current issue it was decided this research should focus on identifying themes within the participants understanding. This would provide the researcher with scope for further investigation of the subject in question. It was therefore decided that the most appropriate method of analysis would be a thematic analysis. However, it should be noted that this approach has been marred with criticisms because its guidelines lack clarity when researchers employ it (Fielden, Sillence, & Little, 2011). Because of this, some researchers have omitted ‘how’ while analyzing the outcomes (Attride-Stirling, 2001).

The information that was gathered from several interviews as well as observations was translated by the researcher; in the process, the initial ideas and feelings were written because this is termed a critical step in the analysis (Riessman, 1993). Afterwards, the translated information was read severally and recordings listened to repeatedly to ensure the precision of the translation. The process of “repetitive reading” (Braun & Clarke, 2006) coupled with the utilization of recordings for listening to the information, leads to data immersion, thus implying the researcher’s close relationship with the information. After the initial step of building on ideas as well as notes created via translation alongside immersion of data there exists the coding phase. These codes enabled the identification of the data characteristics, which the researcher views as relevant to the research question. Moreover, because the method is intrinsic, the entire set of data was equally treated to enable repetitive patterns in the data to be considered fully.

The third step entailed the identification of thematic concerns, which would help in explaining larger parts of the information through combination of several codes that are similar in the data. All the first codes that are pertinent to the question used in the research were integrated into the theme. Additionally, Braun & Clarke (2006) also proposed that thematic maps be created in order to assist with the production of themes. Such would help researchers in reflecting and considering the links as well as correlations between themes. Notably, any themes that lack significant data or have a huge variation were not considered. Additionally, further coding occurred in this phase to ensure that any codes that had been omitted in the initial phases are included. The analysis progressed to the fifth stage, immediately after the emergence of a well-defined picture of the different themes and how they were joined together. This entails describing and renaming the themes, each theme should be defined clearly and analyzed comprehensively. The final phase started after the final preparation of themes that were required for commencing the final analysis and creation of an accurate and interesting report.

With regard to the observations and semi-structured interviews, utilisation is made of thematic analysis with the aim of reaching the maximum level of ‘sense’ by examining the responses of the participants to the questions in the interview and also the observations of the teacher. Important statements emanate from the observation of the teachers and the responses of the participants. These statements subsequently develop into ‘themes’. These themes are categorised into groups relevant to their meanings. Two different classifications of themes are presented, namely (i ‘designated’ (main) themes and (ii) ‘emerging’ themes. Please see appendix (21),(22), (23) and (24) for more details.

The principal themes have a direct link with the answers to the study questions. The themes which emanate encompass all other important participant statements. These supply further information and make a contribution to the comprehensive ‘sense-making’. Each interview’s output is co-ordinated into defined (principal) themes according to the important statements of the participants in the format of their responses to the questions.

The codes were, in fact, the closest names to the meanings they portrayed. For example, *as you know that I do not use technology in this school at all, but I can answer your question from my experience in this school. I found that the attitudes of the head teacher are directly related to the availability of technology and the use of it in the classroom…..* An example of a deductively developed code follows (The challenges faced with the use of technology), which was further split into three sub-codes (Teachers themselves, school or government), (Training teachers to use technology, technical support or teacher attitudes and beliefs), and (How can we overcome the previous three main obstacles?) Finally, from the categories I generated codes concerning the obstacles to using technology in primary schools in order to help students with difficulties in mathematics in the Kingdom of Saudi Arabia. The same themes for interviews were used in order to make it possible for the researcher to compare the data. The same themes were used for interviews for the purpose of allowing the researcher to make a comparison of the data.

4.8 Ethical Considerations

Silverman (2000) suggests that researchers should understand that when they are conducting their research studies, they are, in reality, moving into their participants’ personal spaces. Therefore, this requires addressing of the ethical concerns during and after the study. According to Creswell (2003), the researcher has the responsibility of ensuring that participants' rights are taken into consideration. Based on this notion, I duly applied to the School of Education Ethics Committee at Durham University (Appendix one), which assessed the ethical integrity of my research, and then gave me approval and permission to go ahead with my study. Because of ethical issues the study conducted in accordance with the British Educational Research Association Revised Ethical Guidelines for Educational Research (2004).

In conducting this study, the researcher had to provide five categories of the most important ethical issues. Firstly, the researcher informed the participant as fully as possible on the purpose of the research. Secondly, the researcher ensured that all participants (mathematics teachers) signed the informed consent, without coercion, before the observations and interviews began, and the researcher gave these teachers a copy of the consent document. Thirdly, the researcher ensured that each participant's identity alongside their personal information is kept in secrecy, thus during the translation process their names were not included. Fourthly, the researcher made it clear to all participants that they were volunteers in this project and could withdraw any answers that they had provided, or withdraw their participation at any time without penalty. Lastly, the researcher ensured an accurate presentation of what was observed and what was said, without taking the interview responses out of context.

4.9 Summary of methodology

Notably, the design can be traced to the University of Durham, where the supervisor signed a formal letter and sent it to the Cultural Bureau of Saudi Arabia, in London. The letter was requesting for approval concerning a research that was aimed at obtaining information (see Appendix 9). The letter was responded to by sending a letter via email from London to the University of in Saudi Arabia seeking approval for the study to be undertaken. The letter clarified the duration; questions alongside the topic of the study were clarified in the letter. To be approved, the letter was transferred from University to the Embassy of Saudi Arabia.

I received permission from the embassy of Saudi Arabia in London to conduct my study, and from the Ministry of Education in Saudi Arabia to visit two primary schools there. After choosing a school, I came back to the Ministry of Education with the details of my project.

The study was conducted at two primary schools in Saudi Arabia, which were chosen because the researcher know the area well, thus making it easier to efficiently direct my project to the schools I was interested in. The main reason for choosing primary schools for my project is because good-quality early education benefits pupils in the long term. Aubrey, Dahl, & Godfrey (2006) make a convincing case that these years are a time when the brain undergoes rapid development.

I chose male students in my study is because students in the Kingdom of Saudi Arabia in all levels at schools must be in single-sex classes and be taught by a teacher of the same gender. Therefore, a male researcher will only have access to boys-only schools.

I went to both schools to introduce myself to the headmaster as an academic researcher and to explain my research in person. It was important to involve stakeholders, as well as anyone who would be involved in collecting or obtaining data, in my pre-data collection planning. This helped answer questions or address any issues that may have impeded or delayed data collection. Typical questions were: “who are the stakeholders?”; “how do they need to be involved?”; “when do I need to collect the data?”; “what data will I be collecting?” and “what are the methods I will be using?” At the end of day, the headmaster told me what topic they would be teaching to each class, and the timetable. All information sheets and consent forms were translated into Arabic and given to the mathematics teachers for signing without coercion. Also, the researcher gave these teachers a copy of the informed consent document. The following day, I received the consent forms from one teacher in school A; I started to organize the observation times and arrange to interview the teachers.

Six mathematics teachers with various academic backgrounds were participating in this study, all of them had between five and twenty six years’ experience in teaching mathematics. Three of these teachers in school A use technology with their students who have mathematics difficulties and another three teachers in school B do not use it with their students. The researcher interviewed each one of these six teachers and ask them general questions about the use of technology (Part one) (see Appendix five), then each one of them were observed in their classrooms and, finally, the researcher again interviewed each teacher individually asking them specific questions to address my research questions (Part two) (see Appendix seven).

In the middle of first week, the researcher started to interview one of the teachers who had returned the consent forms in school A with technology (see Appendix four). During the first part of interview sessions, the researcher tape-recorded the interviews with the permission of the interviewee and transcribed them. This interview was generally 35 to 45 minutes' duration. In addition, during the interview, the researcher took notes (see Appendix 13), and participants were reminded that breaks were allowed if they felt the need to do so. It is important to note that all the interviews were tape-recorded and notes taken during the interviews.

The fourth day of the first week, the researcher reached the school 20 minutes before the class began. The researcher went with a teacher in school A to the classroom and sat at the back, where the researcher could see the whole class. At the beginning of the lesson, the teacher told the students the purpose of my presence there. It is important to mention that the researcher observed each teacher with hand written notes for 45 times separately (see Appendix 12), 45 minutes each time, over a period of three months, from the end of September 2014 to the fourth week of December 2014.

In the second week, the researcher continued to interview the same teacher in school A by using the second set of questions, also for about 35 minutes. During the third and fourth week, the researcher interviewed the second teacher, the first day of the third week this teacher was unavailable because he was ill with flu, and the researcher rescheduled that interview. The next day, the researcher interviewed him for about 40 minutes. In the middle of the fourth week, the researcher continued to interview the same teacher in school A by using the second set of questions.

In the fifth and sixth week, the researcher interviewed the third mathematics teacher who uses technology with his students in school A, during which the researcher used the first and second sets of the interview questions, which was in a different week. The researcher continued on this way with the three remaining teachers, during which the seventh and eighth weeks, the researcher interviewed the fourth teacher in school B without technology. In the ninth and tenth week, the researcher interviewed the fifth teacher in school B. In the last two weeks, the researcher interviewed the sixth teacher in school B.

At the end of the twelfth week, the researcher thanked the teachers and the head teacher as well, for the opportunity to conduct the study in both schools A and B, as they were very cooperative. At the beginning of the January 2015, the researcher returned to my advisor to show the results of my research, and he sent a confirmation letter to the embassy of Saudi Arabia in London confirming that the data collection period had ended. Finally, I returned to the United Kingdom to meet with my supervisor, Steve Higgins.

To back to my research questions the researcher found from the interviews' responses of all six teachers and the consequent observations, that the head teacher's support was the main reason behind their decision to overcome or not overcome the obstacles they face when using technology to help students with difficulties in mathematics. The principals of both schools played a crucial role in managing the challenges they faced with technology. This became evident when the head master of school A helped the teachers in overcoming the obstacles they faced when using technology by training teachers and through technical support, which reflected positively on teaching and learning mathematics, leading to a continued and enthusiastic use of technology.

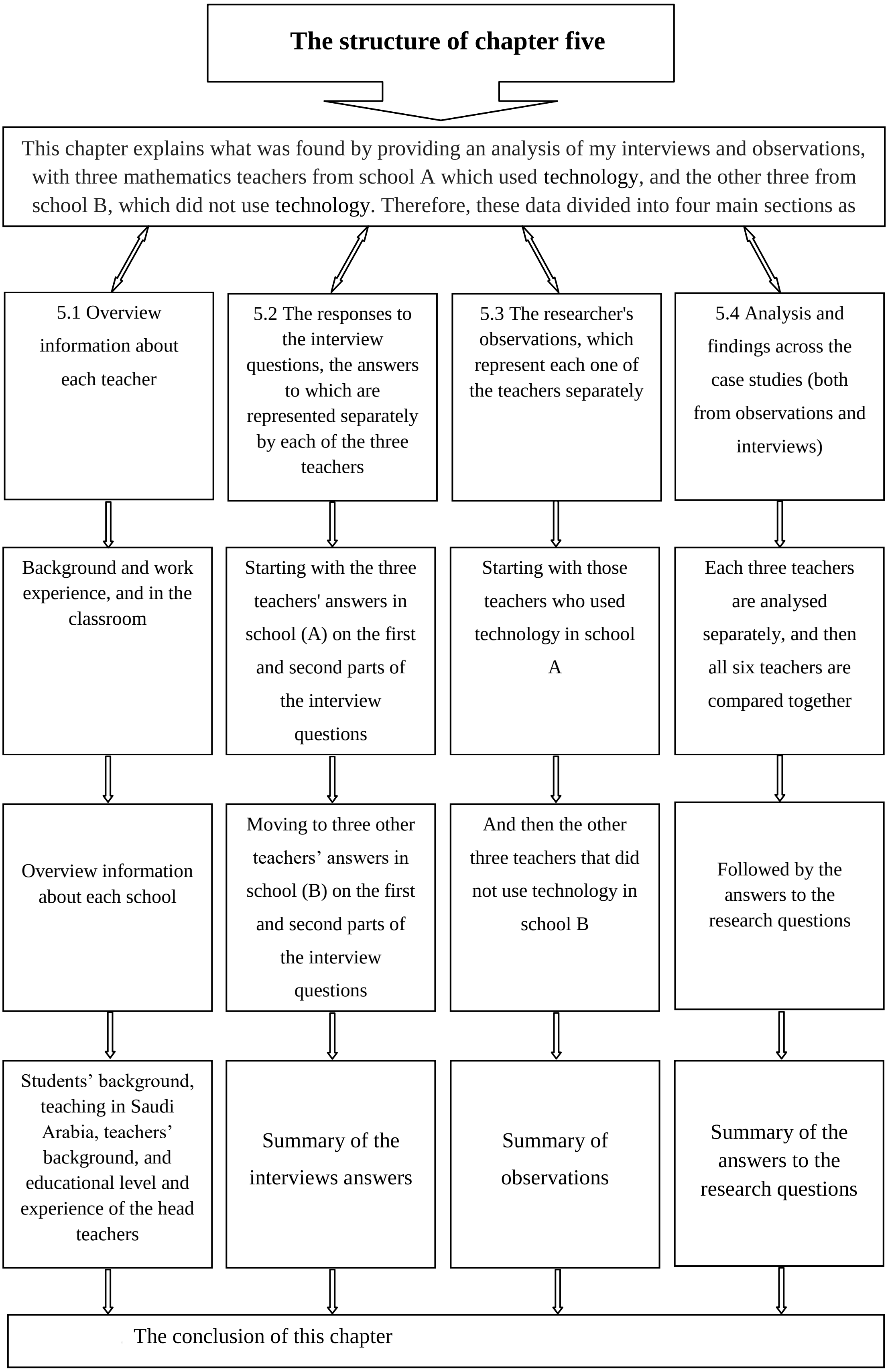
On the other hand, the head teacher in school B did not help or support his teachers in providing technology in school, nor help with overcoming the challenges they faced with technology because of his attitude towards technology in general, which reflected negatively on their enthusiasm to continue to overcome barriers such as the provision of technology in the school, and the lack of training and technical support, in spite of their belief that technology has a positive impact on teaching and in the learning of students who have difficulties in mathematics.

4.10 Conclusion

The aim of this chapter is to provide the reader with a clear picture of the steps that were taken to prepare these instruments and implement them on the research sample. This is then followed with a discussion of the research methods and instruments that were used to collect the data for this research and the reasons these methods and instruments have been employed. Finally, there is a description of how the data was analyzed followed by the ethics to be applied in this study. The following summary in Table (4.1) shows the research questions that were used in this study, the tools that were used to answer the research questions and the methods that were employed to analyse the data.

Research questions	Methods	Analysis	Key issues
1. Why are some mathematics teachers overcoming the obstacles they face when using technology to benefit their students?	Interviews and observations	Thematic analysis	The key issues are to do with the difficulty of getting an accurate understanding of what happens in the classroom, so I designed a balance between my observations and the interviews. As a result, this design left me to draw some conclusion about the use and non use of technology using observation and interviews. This is because in the interview I might not have got an accurate picture of what happened in the classroom. In addition, observations may also be that the teacher does either a different explanation or a discipline or may do something unusual.
2. Why do some mathematics teachers not succeed in overcoming the obstacles that prevent them from using technology to benefit their students?	Interviews and observations	Thematic analysis	

Table (4.1): Summary of the research methods and limatation


The structure of chapter five
This chapter explains what was found by providing an analysis of my interviews and observations, with three mathematics teachers from school A which used technology, and the other three from school B, which did not use technology. Therefore, these data divided into four main sections as
5.1 Overview information about each teacher
5.2 The responses to the interview questions, the answers to which are represented separately by each of the three teachers
5.3 The researcher's observations, which represent each one of the teachers separately
5.4 Analysis and findings across the case studies (both from observations and interviews)
Background and work experience, and in the classroom
Starting with the three teachers' answers in school (A) on the first and second parts of the interview questions
Starting with those teachers who used technology in school A
Each three teachers are analysed separately, and then all six teachers are compared together
Overview information about each school
Moving to three other teachers’ answers in school (B) on the first and second parts of the interview questions
And then the other three teachers that did not use technology in school B
Followed by the answers to the research questions
Students’ background, teaching in Saudi Arabia, teachers’ background, and educational level and experience of the head teachers
Summary of the interviews answers
Summary of observations
Summary of the answers to the research questions
The conclusion of this chapter

Chapter five

Data Analysis

5.0 Introduction

As I mentioned in the first chapter, the study aims to help improve the quality of teaching mathematics, in these two schools in the Kingdom of Saudi Arabia by investigating the obstacles to the use of technology in teaching mathematics. These specific objectives can be classified as four points. The first is identification of obstacles to the use of technology in primary schools in order to help students who have difficulties in mathematics. The second is understanding why some mathematics teachers are overcoming the obstacles they face when using technology to benefit their students. The third is understanding why some mathematics teachers are not successful in overcoming the obstacles that prevent them from using technology to benefit their students. The fourth is determining whether the use of technology has a positive effect on students who face difficulties in mathematics according to the data collected in this study.

To achieve these goals I chose interviews and observation as techniques to collect the data. The observations were crucial to see the effect of the use of technology/non-use of technology on the students' mathematical learning. However, observation alone was not enough to achieve the rest of the objects of my search. As I wanted to investigate the barriers that teachers face when use technology, and why they overcame obstacles and why not, face-to-face interviews were probably the best approach to answer these questions.

Therefore, this chapter explains what was found by providing an analysis of my interviews and observations conducted with six mathematics teachers. These were three teachers who used technology with their students in school A, and another three who did not use technology on school B. Thus, these data are divided into four main sections as follow:

Firstly, section 5.1 presents an overview of information about each of the six teachers and school A and B, which consists of the educational background and work experience, describing the classroom, teacher and students' backgrounds, teaching in Saudi Arabia, working hours, teachers' backgrounds, and educational level and experience of the head teacher. Followed by the role of researcher, which presents in 5.2. It is significant to indicate that the portrayal of every school and teacher follows a like structure, with a difference which depends upon the breadth and depth of the data which has been gathered. All of this information is important when examining the factors that may have enabled or may have limited their use of technology in schools. This means to explore the two research questions: Why are some mathematics teachers overcoming the obstacles they face when using technology to benefit their students? Why do some mathematics teachers not succeed in overcoming the obstacles that prevent them from using technology to benefit their students? Some of the information is gathered from my interviews and observations of teachers. In addition, the information provided to me by the student advisor at these schools is taken from official documents.

Moving to Section 5.3, this shows the responses to the interview questions, in which each of the three teachers presents their answers separately as a summary table as well as in a detailed form, starting with those teachers who used technology, and then the other three teachers who did not use technology. Moreover, the section moves on to the summary of the interview answers.

Section 5.4 presents the researcher's observations on each one of those three teachers in school A who used technology, presenting all of them as a summary table and then each one as detailed separately. These observations included the description of the classroom during my 45-day observations, information about the students in this classroom, the lessons for which this teacher tried to use technology, the types of technology used in the classroom and how, the effects of technology on students with difficulties in multiplication, and the challenges faced during the use of technology. In addition, presented are the researcher's observations on each one of the other three teachers in school B who did not use technology; all of them are presented in a summary table and then each one is detailed separately. These observations included the description of the classroom and my observations, mathematics as a difficult subject for the students, the method of teaching the students and its impact on teaching and learning mathematics, and a summary of observations.

Finally, section 5.5 presents the analysis and findings from both the interview responses and the researcher’s observations, which are divided into four categories: teaching approaches, the effect of technology on students who have mathematics difficulties, the challenges faced during the use of technology, and mathematics difficulties. In each category, the analysis starts with all three teachers who used technology together and then moves to all other three teachers who did not use technology together, and finally compares all six teachers together. This is followed by the answers to the research questions which are in section 5.6. Constructivist and technology, and the role of culture in learning mathematics, which presents in 5.7 and 5.8 respectively, and the conclusion of this chapter in section 5.9.

5.1 Overview information about teachers

5.1.1 Teacher one

5.1.1.1 Educational background and work experience

He holds a Bachelor’s Degree in Mathematics. This degree focused essentially on learning, teaching, curriculum, and mathematics. Moreover, it provided him with the opportunity to draw on pedagogical expertise from a diverse range of sources. He said that it was important for him to learn to use what he has learnt and to work with those students who have difficulty in learning the concept of multiplication. This teacher also benefited from his teaching experience of around 15 years.

He began his teaching career just after the completion of his bachelor’s degree, and he has taught mathematics at three urban schools in the Kingdom of Saudi Arabia. He attended various training courses including the use of technology in mathematics education, towards technology integration in mathematics education, and the role of technology in teaching and learning mathematics. It is important to mention that he attended these courses during the school time.

5.1.1.2 In the classroom

Some students in this classroom have difficulties with mathematics, one of which is related to when they deal with multiplication. Their teacher felt that learning the concept of multiplication and the multiplication tables were more important than mastering addition and subtraction concepts because if his students understood the basics of multiplication, it will make it easier for them to understand multidigit multiplication, division facts, long division, and fractions. Conversely, if some of these students do not know the tables well, they will have a hard time completing the problems and exercises quickly.

To describe the classroom, I would like to start with the class size as one of the factors which needs to be taken into account when evaluating a school's effectiveness. Although the head teacher in this school has relaxed rules and class sizes can be above 28 to cope with the growth in number of students in Saudi, this teacher is not allowed to have more than 20 students in a class for various reasons. With this in mind, I asked the teacher what are the effects of class size on quality and on children's learning and development? He gave the following reply:

> *Class size reduction will have a big effect on achievement, which includes allowing more individual attention, performing better in learning the concept of multiplication when compared to their peers in larger classes, more likely to interact with me rather than listen passively during class, spending less time on discipline and more time for instruction, and finally having greater access to technology.*

Moving to the classroom environment which also reflects the quality of learning, I noted that he began his class by greeting the class full of students with a smile; then, he introduced the topic to the students and asked them what they expected to learn from the topic. It is worth mentioning that this teacher and his students moved from the classroom to mathematics laboratory for most lessons. In the laboratory I found a collection of technological tools, teaching aids, games, and other materials for carrying out learning activities. These were meant to help the students learn and develop an interest in mathematics and could be used either on their own or together with their teacher.

In the last ten minutes of class time after the lesson was taught, the teacher asked some students to explain what they learnt. He then asked them to sign in to their assigned computers, where they found a programme that helped them practice what they had learned during class. The students usually started with the low-level assignments and challenged themselves as they moved to higher levels. Meanwhile, the teacher walked around and noted the final mark of each student to assess their needs and get valuable feedback on the topic they learnt. In some lessons, the teacher asked some students to come to the board to practise the same tasks that they learnt during class, and instead to sign into their assigned computers. Finally, when those students went back to the classroom, the teacher gave them a homework assignment.

With regard to how this teacher dealt with his students, I noted that while this teacher interacted with his students using physical gestures, he also connected with them at the emotional level. He always smiled while talking to the students, thus reassuring them of his affection towards them; his passion for teaching could be seen in his body language, chosen words of speech, and speech inflection. He often connected the lesson to the things outside of school in order to improve the students' imagination and help them remember what they learned; his heart was open and receptive to the students.

He constantly improved himself to ensure his students received the highest quality of teaching. He also shared what he learned with his colleagues, if this was in the best interest of the students. Furthermore, he saw criticism as an opportunity to grow as a teacher. This teacher created a welcoming learning environment for all the students, which made those students respect him and go to him if they had problems or concerns and even if they wanted to share a funny story.

With regard to how this teacher used technology, I noted that this teacher was confident using technology and handling more difficult technological issues. He used the interactive whiteboard at every class; he spoke positively to students about the positive effects of educational technology and that they must use technology that would help them make good progress in their learning and refrain from using technology that was detrimental to their learning. He made efforts to get appropriate safety and privacy when he needs to use the whiteboard.

This teacher was distinguished in terms of his ideas and the way in which he taught his students. He preferred small-sized classes to increase student achievement. While I agree with him on this point, many other factors besides the size of the classroom play an important role in enhancing the students' development in school. For instance, the experience and preparation of the teachers are critical factors that help children benefit from a small class size. This teacher also benefited from his teaching experience of around 15 years. Therefore, he was able to deliver information in a creative way, e.g. using technology in the mathematics laboratory. In addition, he also gave the students the opportunity to use technology when doing their homework at home.

5.1.2 Teacher two

5.1.2.1 Educational background and work experience

This teacher graduated with a degree in mathematics from the Kingdom of Saudi Arabia (KSA). He was appointed as a mathematics teacher at a primary school in another city before he moved to this school. He had around 16 years' experience as mathematics teacher in primary schools. He attended some of the training courses about the use of technology in education.

The reason why he attended these courses was to understand computer systems at a deeper level and to be able to help those students to who find it difficult to learn mathematics. In addition, after the school time, he used every opportunity he received, to gain expertise in computing and the ability to solve complex and challenging problems. Therefore, he learned how to use new technology not only to increase his salary but also to help his students with mathematics.

5.1.2.2 In the classroom

As we know that the classroom is the main place of learning. This teacher equipped his classroom with technological tools to better adapt to the current changes. This class was spacious and all the learners were able to perform tasks productively. However, his class had about 20 students, and this teacher agreed with the opinion and belief of teacher one about the effect of class size on students' achievement.

Electrical outlets were available; however, the teacher used one socket only for the interactive blackboard, since this teacher did not carry his laptop or iPad to the classroom. He thought that the important things that a classroom must contain are an interactive whiteboard and comfortable desks and chairs for students so that they feel at ease inside the classroom.

Moving on to how this teacher dealt with his students during the lessons, I noted that this teacher had a good sense of humour and he ensured that students never felt bored. All the students respected him, and he gave all the students the same amount of respect and tenderness. In addition, if some students were not interested in learning even with the use of technology for any reason, he tried to help them overcome any barriers and get back to the lesson. The facial expressions of this teacher and the way in which he spoke to the students showed that he was very pleased to teach them.

This teacher had a few favourite technological tools that used to make the lessons easier and more fun for all the students. Of note, when this school adopted the interactive whiteboard, this teacher did not mind taking help from students to use this technology appropriately; it could be said that the students were more tech-savvy than the teacher. This teacher was well aware of the positive impact of this technology on the development of students; he addressed the obstacles he faced when using these technological tools to take their full advantage. He also used excellent teaching strategies to help his students achieve their full potential. He was able to integrate his ideas of teaching mathematics with technology to raise the level of student attainment. He also had strong classroom management skills; he was able to teach across Key Stages four and five and was able to efficiently plan, prioritise, and organise.

This teacher had experience in both technology and mathematics; he used his expertise in both fields to design and develop software that could help students learn mathematics. In addition, he used technology to connect the knowledge and skills learnt during the lessons to the real world to help students feel excited about learning mathematics. For example, he used short videos to demonstrate how the concept of multiplication is used in the real world and in which professions this concept is used frequently. This teacher was found to have a positive long-term effect on the lives of his students as he desired to make a difference to them. He was very clear with his students, as can be seen from his teaching methods. For example, he wrote the lesson objectives on the board at the beginning of the class to give the students a clear idea of what they would be learning.

5.1.3 Teacher three

5.1.3.1 Educational background and work experience

He had a bachelor’s degree in mathematics; and he attended some of the training courses about the use of technology in mathematics education. He is an educator with many years of academic experience, where he has held a number of positions in the last 14 years, including the position of the teacher and students' advisor.

He was very enthusiastic and coordinated extra-curricular activities both in the school and in the wider community; for example, he organised a visit to The SciTech Technology Center, also known as the Sultan Bin Abdulaziz Science and Technology

Center, to help his students understand the fundamentals of mathematics by presenting them in a modern and fun interactive format. This visit was arranged in advance by coordinating with them, with permission from the parents of his students. His head teacher mentioned that his creative outlook and energetic spirit made him a welcome member in the school team, and that he did not want to lose this teacher.

This teacher had a passion for technology in the classroom; he was determined to use technology to its full potential to make a positive difference to the learners. In addition, he believed in strong communication between the parents and the school, to help the parents to learn more about what goes on in the school and encourage learning at home. For example, in some lessons, he sent some pictures taken during the lessons to the parents so that they could see their sons' progress.

His hobbies are camping, sports, reading, and exploring. He loves nature and animals, especially deer.

5.1.3.2 In the classroom

His classroom was attractive and functional as he took into account both the students' needs and instructional goals. I have already witnessed how the classroom environment can affect a child's academic progress. His classroom had four small windows with curtains, which he would open to let the natural light in. In the right corner of the classroom, he placed plant to make the classroom more welcoming and improve the air quality as this classroom was air-conditioned. I found that he designed the seating arrangement in a systematic way, to help students feel more comfortable and be able to see the instructions of the teacher clearly. With regard to bulletin and display boards inside the classroom, I noted that he designed a panel to display the work and achievements of his students to drive healthy competition between them; this display also helped the parents and other officials keep track of the students' academic progress in mathematics.

This teacher believed that the interpersonal relationship between him and his students was an important element in the classroom environment. Indeed, I noted that he had a positive relationship with the students; he was friendly and showed respect to the students from various cultures and backgrounds and treated all of them with fairness and equality. He never discouraged the students from achieving something that was not related to mathematics or technology and also helped them become aware of how mathematics was applied to real life problems. The students felt comfortable and safe with him, evidenced by the fact that one of the students came to this teacher with non-academic concerns that affected his life, and the teacher tried to help this learner.

I noted that he did not have extensive pedagogical knowledge, for example, he could not deliver the information directly to the students. However, he had good content knowledge about the facts, concepts, theories, and principles in mathematics. Moreover, he understood the nature of knowledge. This teacher had excellent technological knowledge and was confident when using technology to teach his students. For instance, he had the skills required to use particular technologies and to install/uninstall software programmes.

My impression of this teacher is that as he has held a number of positions over the past 14 years that have had positively influenced his career. This is evidenced by his personality traits, e.g. openness, respectful of other cultures, able to work under pressure, critical thinking and problem solving, and teamwork and communication. His educational background reflects his wide expertise and qualifications. His qualifications have enabled him to use technology confidently, understand the essential concepts of computer programming, and have a positive attitude towards educational technology during class; he is also willing to benefit his students by visiting The SciTech Technology Center and he also understands the ethical issues pertaining to the use of computers. Meanwhile, he also focused on his goal of using technology for the benefit of those students who have learning difficulties.

5.1.4 Teacher four

5.1.4.1 Educational background and work experience

This teacher holds a bachelor's degree in mathematics. After graduating, he was qualified to teach mathematics at a primary school, and he preferred teaching in the south of the KSA because his family and parents live there. However, he was appointed to teach in a primary school in the east of the KSA. It is important to mention that at the beginning of his placement, this teacher did not try to get a transfer to his hometown, as he strongly believed that a good teacher continues to move with his students from the first grade of primary school until they graduated (Year one to Year six). As he was aware of the needs of his students, he found it easy to work with them during the primary stages. However, his family missed him and his parents needed his help as they were elderly, so they pressed him to return back. As a result, this year, he requested a transfer to his hometown, and waiting for the response of the Ministry of Education to his request, and he hopes to meet the standards required for a school transfer from one region to another region.

5.1.4.2 In the classroom

His classroom had 30 tables and chairs, one traditional desk for the teacher, one traditional board, and colourful carpeting. With regard to the seating arrangements in this classroom, I noticed that the students did not occupy the same seat every day. Their teacher asked them not to occupy the same seat every day, as the person who came first to the classroom was given a chance to sit in the front seats. As a result, the students came early to school to occupy the front rows. The classroom walls did not have any display boards with the students' work or art, and the classroom had four small windows. There was no storage area for the students' jackets and backpacks.

Regarding how this teacher dealt with his students, I noticed that he was very friendly with students. However, he was a strict teacher when they made noise in the class. The teacher taught students with different levels of learning difficulties in mathematics. Moreover, this teacher did not encourage the students to ask questions about the lesson.

Finally, regarding the knowledge he had about technology, he understands the positive of the use of this technology with the students who have mathematics difficulties. Therefore, he hopes it will be incorporated into this school to benefit the students in overcoming these difficulties. At home, he allowed his children to use technology, such as iPad or computers, for education only, because he did not want his children to access inappropriate material or play violent video games.

This teacher's idea of allowing the students to occupy any seat was effective in encouraging students to come to school early, so that they could attend their morning exercises in the massive school courtyard held by a specialist sports teacher for about 15 minutes before the classes began. With regard to how this teacher dealt with his students, I think the serious and strict attitude of the teacher could have a negative impact on the development of students with difficulties in learning mathematics.

5.1.5 Teacher five

5.1.5.1 Educational background and work experience

He had a bachelor's degree in mathematics. During his time at the university, he also worked part time to gain experience and help himself and his family. This teacher added,

> *I will do my best to help my family. I know it is hard to do this as a student, but I wanted to pursue my dream to be a mathematics teacher.*

After he graduated, he started his teaching career as a primary school teacher in the east of Saudi Arabia. He spent two years there teaching mathematics to Key Stage four and five students who had learning difficulties; he then decided to move to this school to teach mathematics. He is currently enjoying his first year as a Year five teacher.

He always promotes optimism, because he believes that, if the students become more optimistic, they will achieve high levels of performance.

5.1.5.2 In the classroom

This teacher prefers to teach at the school library; therefore, I noticed that for some lessons he took his class to the school library where the sky was visible from the windows. The question arising here is how these students went to the library. He would usually wait for his students at the library, and when the mathematics class began, they would themselves move from their classroom to where he was, and then, at the end of the class, they returned to their classroom.

The main area inside the library had a large open space with four large windows and a one big table with 32 comfortable seats (with armrests and a curved back) surrounding it. This library had a balanced collection of print and audio materials. However, there was no technological tool available such as interactive whiteboard or projector. This teacher wanted to use technology but he needed guidance to use the tools efficiently.

With regard to how this teacher dealt with his students, he was friendly but strict when required. He believed that a mixed approach should be followed, as both approaches are correct to a certain level.

I know that balancing study and part-time work is not easy, and this teacher needed to earn money to support himself and his family as well as complete his degree. However, I think work experience is an important part of a CV, so the various aspects of the work experience of this teacher could benefit him, e.g. dealing with students positively, understanding organisational conditions, managing work systematically, building a team spirit among the teachers, providing support and encouragement to his colleagues, promoting a clear vision, managing time effectively, and being patient with students. He always had a positive attitude, and this affected the way he taught his students. For example, he was optimistic about the future, and always advised his students to be optimistic in life.

5.1.6 Teacher six

5.1.6.1 Educational background and work experience

This teacher was born and raised in the north-western part of the KSA. Some of his family members are teachers from whom he learned the importance of teachers in helping students to be responsible and productive members of society. He had struggled in school, especially with mathematics. When he reached Year 10, he found a good mathematics teacher who had perfect content knowledge of mathematics and was able to explain various concepts well using technology; he helped him when he had difficulties performing any task by showing him how to solve the task, explaining various concepts, and why the topics were worthwhile in the future; he motivated him by giving him rewards such as certificates and verbal praise instead of criticising wrong answers. As a result, this teacher started developing a liking to mathematics and its challenges. Moreover, he was encouraged choose mathematics as a subject at university when he was pursuing his undergraduate degree.

He graduated with a BA in mathematics before moving to the east of Saudi Arabia. There he spent five years in three primary schools teaching Year four and Year six students. During his time in the first school, he decided to attend some training courses in Special Education, because he was keen to have a positive influence on students who have difficulties in mathematics. In this school, his class has a range of students with difficulties such as failing to understand that any number multiplied by zero equals zero. These courses assisted him in his efforts to help his students.

He happy to be a part of this school's teaching family because during his experience in this school, he understood that there is no place for bad teachers in this school; he realised how important good teachers are and how much of a positive impact they can have on students with difficulties. In addition, they are responsible for educating them correctly, meeting the specific learning needs of students with difficulties, and helping them develop their knowledge and become the leaders of the next generation. Indeed, I noticed that he desired to move from one school to another. He stated:

> *I am interested in teaching in different schools and cities to get the opportunity to teach many different students from different backgrounds and to see the differences between schools.*

5.1.6.2 In the classroom

This classroom was overcrowded with 35 students; this teacher did not make any special seating arrangements for his students. As a result, his students had the freedom to sit wherever they wanted but I noticed that not all students got a clear view of the front of the room. Moreover, the teacher found it difficult to manage this classroom successfully, so he spent more time managing his classroom than teaching.

Moving on to how this teacher dealt with his students and technology, I noticed that he was very friendly with students. With regard to the use of technology, I noticed that in the first week, the teacher used his laptop and projector during teaching, and from the second week to the end of the last week, he did not use these tools with his students, which negatively affected his students' progress. This appeared when this teacher returned to the traditional method of explaining the topics. The significant point here is that in some lessons, during the last ten minutes, the teacher asked some students to provide the lesson that he had already explained to them, as he wanted to measure their understanding. I found that the majority of the students did not want to provide the lesson except for three students who raised their hands, as they wanted to participate. This may have been due to the fact that the majority did not understand the lesson sufficiently well, and hence, they lacked the confidence to give the lesson or explain what they had learned.

As this teacher had an unpleasant experience with mathematics when he was a student in school, and he found a good teacher who made him love mathematics, he wanted his own students to love mathematics and excel in the subject without difficulties. I could notice his desire to achieve this aim. This appeared in his keenness to attend training courses in Special Education to have enough skills to teach students with difficulties. In addition, it was also clear when the teacher used his laptop and projector to help those students to overcome their difficulties with multiplication.

It is an important to mention that all the above information (an overview of information about each of the six teachers and describing the classroom) are gathered from my interviews, observations and the student advisor. All these are important when examining the factors that may have enabled or limited the use of technology in schools.

5.1.7 Overview information about the schools

5.1.7.1 School one

This school is a government-run primary school. It is an urban school situated in the eastern province of the KSA. The school is currently staffed by a head teacher, assistant head teacher, two student counsellors, an observer, 27 teachers, and a school cleaner and caretaker.

The school was well equipped with computers. It had all the facilities of a modern school. The school had two floors: the ground floor housed the offices of the head teacher, assistant head teacher, student counsellor, and observer; a learning difficulties unit; a science laboratory; a library; Year one and Year two classrooms; and washrooms. The first floor housed the mathematics laboratory, student counsellor’s office, staff room, Year three and Year four classrooms, and washrooms. The second floor housed the student counsellor’s office, Year three and Year four classrooms, and washrooms. The school also had a playground and a multipurpose ground for activities and morning assembly; the building was well fenced.

The school is locally reputed for its quality educational programmes, especially for the students who have difficulties in learning. For example, when the teachers notice that any student has difficulties with learning, they immediately transfer those students to a resource room. In this room, the student usually has to take a test to help the teachers know what type of difficulties the students have in terms of three major sections: mathematics, reading, and writing.

5.1.7.2 Students' background

The students' background plays a major role in their performance. According to the information provided to me by the student advisor at this school, that some of the students' fathers in this school work in the educational and health sectors and are employees in private companies. Some others are in other government sectors or are self-employed. There were 650 students in this school: Most of the students came from urban areas, and some of them are foreign students who came from, for example, Egypt and Sudan.

I found that the amount of time the parents spent with their children during their previous school years had an impact on the development of these students. Most of the students spent enough time with their parents at home when completing their homework. The students' adviser mentioned that there is a factor that may contribute to the differences in the performance of the students.

> *The parents who constantly encourage their children to learn may positively influence their children's progress. This is because they encourage their children to progress during the key stages, check their development, and frequently communicate with the school. On the other hand, the parents who not encourage their children to learn may negatively influence their progress and achievement at school.*

5.1.7.3 Teaching in the KSA

The Saudi government implemented a policy to promote the employment of Saudi nationals in public schools. Therefore, all the teachers in this school belonged to the KSA. In addition, the teachers needed to hold a bachelor's degree to be eligible to teach national curriculum subjects in any school. In this school, all the teachers had a bachelor's degree only. Two types of degrees are offered to students at university: education and non-education. For example, when a student at the university studies educational subjects, such as methods of teaching mathematics, educational psychology and educational research, then this student will graduate in what is called 'education'. On the other hand, when a student does not study educational subjects, this student will graduate from the university with a non-education degree.

The Ministry of Education is striving to improve the quality of teaching and learning. As a result, it stated that students graduating from the university with a non-education degree cannot work as teachers and can work only as administrative staff in the school. However, if these students wish to teach in a school, they must complete a diploma in education. These diploma courses focus on theories from several disciplines that underpin educational practice, curriculum content, and methods of teaching and learning, such as psychology and educational technology, requiring 12 months to complete. All the 27 teachers in this school had education degrees.

In the primary schools in the KSA, usually in Year one, Year two and Year three, there is what is called 'teacher class' that teaches Arabic language and religion subjects; each year has one 'teacher class' separately. To mathematics, science, sport education and art education subjects, the teacher has to hold university specialisation to teach the students one of those subjects. With regard to Year four, Year five, and Year six students, a teacher can teach only the subject that he majored in at university.

5.1.7.4 Working hours

The 27 teachers work full time – 32 hours a week on average. All school levels begin their classes at 7.15 am; Year one, Year two, and Year three finish at 12.05 pm and Year four, Year five, and Year six finish at 1.00 pm.

5.1.7.5 Teachers' background

The 27 teachers in this school have various academic backgrounds. One had 16 years' experience teaching mathematics to students with learning difficulties, some of them had between two to ten years' teaching experience, and some others had between 11 to 16 years' teaching experience. According to the information provided from the student advisor, the extent to which each of the teachers used technology when dealing with their pupils varied. It was apparent that these teachers had different levels of experience with different types of technological tools, as each class required the use of different technological tools.

Before I could start with the data collection process, the school principal mentioned the following:

The thing that I must say to you is that the whole experience is wonderful in this school as all these teachers are friendly with their students. In this school, we do not need student advisors, although each floor has one, because our teachers are highly capable of helping the students.

Indeed, I did not see any student visiting the advisors for any help. Therefore, I met with the teachers and counsellors to find out why the students did not come to the student advisor when they needed any help. I found that most students could share their problems with their teachers without any hesitation. In addition, if the teacher of mathematics knew of any student being absent from the school because of admission into hospital, the teacher would visit that student after class with two or three other students and also carry a small gift for that student, a gesture that was highly appreciated by the sick student and his family. Moreover, the teachers were very kind, had a good sense of humour, were good listeners, and had excellent knowledge and experience when using technology to help students with learning difficulties. Usually, they used their talents to do something extraordinary for the students who were most in need of the teachers' extra efforts.

Some of the teachers lived in the eastern region permanently, and some others came from different regions of the Kingdom.

5.1.7.6 Educational level and experience of the head teacher

The head teacher had a bachelor's degree in mathematics, and diploma in computer science. In addition, he attended some courses, such as the effect of technology on learning, and strategies for helping students who struggle in learning.

He had nine years' experience as head teacher in primary schools. As a result, he gained many skills such as leadership skills, effective communication skills, ability to work under pressure, strong interpersonal skills, and ability to communicate with primary school students belonging to different age groups who have learning difficulties.

One of the mathematics teachers in this school stated he following about this head teacher:

When this head teacher first arrived to this school, he sought to establish himself in this school. He is very clear with us about the kind of leader he is and the *direction he wants us to take. The virtue of humility dominates his personality, where he is ready to learn even from the most junior members of his staff. He always says to us 'I cannot effectively manage the affairs of this school without you'. He promotes a culture of encouragement and support to help the students with difficulties with the highest professional standards. In addition, he also promotes innovation and the use of technology. He makes sure the teachers' performance is evaluated every month and that the evaluation is based on clear principles and is fair.*

I think this school is close to the ideal school for me. I was impressed by the helpful and polite attitude of the office staff, who provided me with the support I needed throughout the three months of data collection. In addition, the head teacher collaborated with the teachers, and all the decisions made were student-centred and promoted educational research. Moreover, all classrooms were equipped with the technology necessary for educational purposes and to help students succeed and be able to use technology effectively in the workplace after graduation. This spirit of teamwork among the teachers and the head teacher alongside the importance given to technological innovation make this school an ideal school.

5.1.8 School two

This is an urban government-run primary school for Years one to six; it has 750 students. The school is currently staffed by a head teacher, assistant head teacher, student counsellor, observer, 32 teachers, and a school cleaner and caretaker. It is also considered to be one of the primary schools that take care of students with learning difficulties, through transferring them to what is called a resource room to measure and assess the type of difficulties they have in mathematics or any subject.

The school building consisted of two floors and 19 classrooms. Two staircases at both ends led to the first floor. The ground floor housed the head teacher's office which was close to the entrance; the offices of the assistant head teacher, student counsellor, and observer; a learning difficulties unit; library; a well-equipped science laboratory; Year one, Year two, and Year three classrooms; and washrooms. The first floor housed the staff room; Year four, Year five, and Year six classrooms; and washrooms. The school building was well fenced. The school canteen was close to the football stadium, which was covered with grass. It is important to mention that the students found that the football stadium was the place they could enjoy themselves during their break time.

This school, like other public primary schools in Saudi Arabia, has a specific uniform for students which is called thawb, and this is a traditional garment for men. It is usually made of white cotton, and it is of an ankle-length with long sleeves and three pockets: one on the right side, one on the left side, and a front pocket on the chest side. It is important to mention that, if any class has sports in their school schedule, they can attend school by wearing sportswear on that day.

5.1.8.1 Students' background

When I asked the student advisor at this school about the involvement of the parents, whether the students received help with homework, who lived with them at home, the regions from which most students came, e.g. urban or rural town, and the child's prior educational experience. The student advisor mentioned the following:

> *I collected the above information from the students at the beginning of the school year to identify the factors that determine educational outcomes and to link the students' background knowledge, by understanding the student's strengths, needs, and real-life circumstances, to the teaching content accordingly and better support the students in the classroom and at home. In addition, when they left the school, this information would help the new teacher to get a clear picture of these students and begin from where these teachers left off.*

I found from the information that was collected by the student advisor from the students that the parent's job played an important role in the children's progress, and I also found that the amount of time the parents spent with their children during their previous school years had an impact on the development of these students. Some of the students' fathers in this school work in the military sector and the private sector or are self-employed. Some others are in other government sectors.

I also found from the information that was collected by the student advisor from the students about the amount of time the students spent with their parents at home when completing their homework. Some of the students spent less time with their parents because of the parents' work arrangements. Regarding information related to who lived with the students in their homes, I found that most students lived with their parents.

Also some information was related to where these students came from: Most of the students came from urban areas, and few foreign students came from, for example, Egypt, Jordan and Sudan. On page four, there was information related to the student's prior educational experience to help them make the most of a new experience. I found that some of the students struggled with mathematics, especially with the concepts of multiplication and subtraction. For instance, the student simply could not absorb the knowledge about multiplication because their prior knowledge about subtraction became nonsensical.

5.1.8.2 Teachers' background

All the teachers in this school were from the KSA and had a bachelor's degree in different subjects; four had a degree in a non-educational field and 28 had a degree in education. This school had a combination of experienced teachers and new teachers. Some of them had between two and ten years' experience in teaching, while some others had between ten and twelve years' experience, which gave their school stability and allowed them to serve as mentors for new teachers. Most of the teachers came from urban areas, except of two of them whose first appointment was in remote areas, which involved between one and three years of experience of teaching in such settings.

It is an important to mention here that some of these teachers tended to have little experience of using technology with their students, often because the schools at which they worked did not have appropriate technology available. Nevertheless, these teachers did express awareness of the positive impacts of technology on student learning.

5.1.8.3 Educational level and experience of a head teacher

The head teacher of this school had bachelor's degree in mathematics. He first taught mathematics in a remote area, in Saudi Arabia. Currently, he has 20 years' experience as a head teacher in primary schools.

One of the mathematics teachers in this school mentioned the following statement about this head teacher:

> *When the bell rings before the morning assembly, the head teacher some days move to the perimeter fence and hurry the students who come late to school up, and he smiles at them and asks them to come earlier next time. He then goes back*

to the morning assembly to see all the teachers and pupils. When this is finished, the head master sometime goes directly to his office or walks around the classrooms. There are some things our leadership is very keen to do; this includes taking time to listen to student concerns if they come to his office or if he meets them by coincidence out of the office, because he believes that when students feel that their head teacher is a caring person, this leads them to be happy in the school environment. He is also keen to provide a safe and calm school environment.

What distinguishes this head teacher is his capacity to create a safe and calm environment at school effectively. And we know the importance of this aspect in student learning, and each head teacher should make sure that this is consistently applied in their schools. In addition, I can see from my visit to this school how the principal deals with some students in a way which he appeared like their father, and I likened this to 'father' because we know how the parents are keen to provide their children with the advice and guidance that help them with strong foundations to build upon in their future life.

5.2 The role of researcher

This section will present the challenges I faced during the data collection. As I mentioned in the previous chapter, the role of the researcher affects the process of data collection and also the data analysis. In this chapter, I tried to separate my personal perception from the observation, and tried to be as objective and impartial as possible. With regard to the interviews, I interviewed the teachers to get a feel of what they were saying, and presented a picture from I saw during the observations. I can say that this is the best, I think, I can do for this description, but it still depends on me.

Coming back to the challenges I faced during the data collection and how I dealt with them. For example, I can see much from the educational background and work experience for teachers four, five and six. Teacher four's first appointment was in this school. This means he did not have any experience working with technology. This is the second school appointment for teacher five, but both schools do not have technology. Teacher six taught at two schools before this school, which is the first school he taught in that has technology and this is due to the positive attitude of the head teacher towards providing technology and encouraging teachers to use it. In contrast to the second and third schools, who do not have access to technology. This is also the same reason behind the responses of the fourth and fifth teacher. Therefore, I asked teacher six the same questions in part that I asked the three teachers at school A who have used technology in their classroom, and benefitted from the experience. However, to be impartial I decided to ask teachers four and five some appropriate questions to help me obtain informative answers to the research questions, and to not ignore the teachers who do not use technology with their students.

As I mentioned early in this chapter, all three teachers at school B knew the positive effect that technology offers to students with difficulties. However, when I started to ask teachers four and five questions about technology to get a picture in my mind about how they knew that technology has a positive effect on students, or simply wanted them to give me evidence about this positive impact, they talked a little bit about it. They felt there were challenges that had to be overcome first, such as providing technology, training on technology, technical support and subject knowledge development. And then I had to ask them about technology and mathematics to give me an answer confidently. However, I tried to be impartial between those six teachers which allowed me to give enough space in this chapter to the description of all answers of the three teachers at school B and also to answer my second research question well. Actually, I remember when I met one of the three teachers at school B, he said to me in each interview, "I hope I can help you much with your research to have enough and useful information"; this is because they thought that my study focused on the use of technology only, which meant that my study would avoid the teachers without technology. I said to him, "Do not worry, I am sure that your information is valuable and you will answer for me one of my research questions."

It is an important to mention that all the above information (teacher and students' backgrounds, teaching in Saudi Arabia, working hours, teachers' backgrounds, and educational level and experience of the head teacher) is gathered from my interviews, observations and the student advisor. All these are important when examining the factors that that may have influenced the teacher's aspirations for using technology. In addition, when exploring the factors that that may have influenced the learning and achievement of the students and the achievement which led them to have difficulties with mathematics. Moreover, when investigating the causes that may have impacted the head teacher's attitudes and beliefs towards technology, which may have subsequently reflected positively or negatively on the teachers' decisions to use technology with their students.

5.3 The responses to the interview questions

Interviews were chosen as techniques for the purpose of this research, therefore, this case study was conducted at two primary schools in Saudi Arabia, with three male mathematics teachers in school A, who use technology with their students who have mathematics difficulties, and three other teachers in school B do not use it with their students.

Each one of these six teachers were interviewed and asked general questions about the use of technology (Part 1). Each was then observed in their classrooms and, finally, every teacher was individually interviewed and asked specific questions to address the research questions (Part 2). It is important to note also that all the interviews were tape-recorded and notes taken during the interviews; each interview took 35 to 45 minutes.

In this section, I will provide the responses to all the interview questions related to first and second parts, respectively; the answers of each three teachers are presented separately as a summary table as well as in a detailed form, starting with those teachers who used technology, and then the other three teachers who did not use technology. Moreover, the section moves on to the summary of the interviews' answers.

The following are the responses of three teachers who used technology, on the first part of the interview questions (see table 5.1).

Questions	Teacher one	Teacher two	Teacher three
1- Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology?	Yes, because the increase in technology nowadays should be exploited by educators.	Yes, for the reason that my students struggle with mathematics; this has prompted me to try a myriad of strategies in a bid to simplify this task. In these endeavors, I realized that the use of technology is an excellent way of making mathematics	I made the decision to draw on technology when educating my students, because technology has grown to be a fundamental part of our daily lives and students have an outside classroom

		seem more entertaining and less intricate. Moreover, Saudi's national public education system curriculum has been overhauled leading to immense changes in the last few years. Due to these changes, I have been compelled to indulge into the use technology in the education process *to* facilitate dealing with the curriculum effectively and to deliver the information to students in a simple way.	experience with it. By integrating the use of technology education, it is possible to spark students' interest in a subject and, as a result, they will be more willing to stretch their brains to learn mathematics.
2-What are the types of technology you use with those students?	I have used an interactive whiteboard.	I have used an interactive whiteboard.	I have used an interactive whiteboard.
3-Does the technology help you cover the key mathematics concepts in the syllabus?	Yes	Yes	Yes
4-Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?	Yes, the function of the interactive whiteboard in mathematics education is to boost the motivation and aptitude of students who experience difficulties in mathematics.	Yes, technology's function the education of mathematics is to reduce and eliminate the adverse results for students who experience mathematical difficulties, particularly by means of early intervention.	Yes, technology's role in mathematics education is to give meanings to numbers, to enhance students' confidence and to aid in boosting the memory of the students.
5-Have you learnt anything new by using	Yes, I learnt how to use the interactive whiteboard.	Yes, I took a course on how to use the interactive	Yes, I took a course, with my colleague, on how

technology in your class?		whiteboard with students who have difficulties in mathematics.	to use the interactive whiteboard with students who have difficulties in mathematics.
6-What are the main reasons behind the decision of the mathematics teacher to not use technology to help students with mathematics difficulties? (Teachers themselves, school, government).	School.	Teachers themselves and their school.	School.
7-What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of: - Training teachers to use technology? - Technical support? - Teacher attitudes and beliefs about teaching mathematics with technology?	Teacher attitudes and beliefs about teaching mathematics with technology.	Training teachers to use technology.	Technical support.
8- Do you need any further support to use technology, and if so, what support do you	No	No	No

need?			

Table (5.1): The responses of three teachers who used technology on the first part of the interview questions

1- Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology?

Before asking the first questions to the interviewee, I thought it would be better to make clarifications concerning the meaning of technology in mathematics education. Therefore, I asked each one the meaning of mathematics education technology for in their view. Teacher one answered:

> *Some people always think that technology means computer only. However, technology is more than computers; it means the computers just a type of technology. As a result, the meaning of technology to me is a set of appropriate tools which include computers, IWB, TV,* video *and projector meant to enhance teaching practices and improve learning outcomes.*

Upon meeting the second teacher, I asked him the same question as that for teacher one, "what is the meaning of technology for you?" He stated:

> *I think this is a good question and thank you for asking me this question; I will answer this question as follow; the meaning of technology in education is development, design and application of tools and techniques to improve both teaching and learning mathematics. The word of tools as mentioned here is Interactive whiteboard, computer and projector.*

Teacher three answered:

> *The employment of human or non-human elements in a particular subject meant to address problems, design appropriate scientific solutions, development, use, manage and evaluate to achieve specific objectives.*

Coming back to the first question as illustrated in Table 5.1 above, the responses to the first question of the first three teachers' interviews that used technology with their students were yes. However, I received three different reasons of their use of technology. The reason of using technology in teacher one was recent dramatic changes in technology in our society at a rapid rate. As a result, teachers should take advantage of the potential of new technology to benefit students. He reported:

> *Yes, because the increase in technology nowadays should be exploited by teachers to benefit students, and we do not have to ignore it. Therefore, we have to continue to keep up with the skills required for technological change that lead to get the most of the advantage of the use of technology in the classroom.*

Teacher two mentioned that he tried discovering what works best in his own classroom situation in terms of find appropriate teaching methods for students who face difficulty in mathematics. In these endeavors, he noticed that technology makes mathematics easier and enjoyable. As a result, students will be excited about the subject throughout their school years. In addition, as the curriculum of Saudi schools is developed and technology integrated into the curriculum, forcing teachers to use technology to keep pace with this change.

Teacher two stated:

> *Yes, for the reason that my students struggle with mathematics; this has prompted me to try a myriad of strategies in a bid to simplify this task. In these endeavors, I realized that the use of technology is an excellent way of making mathematics seem more entertaining and less intricate, which lead the students to be more enthusiastic about learning mathematics.*

He added:

> *Moreover, Saudi's national public education system curriculum has been overhauled leading to immense changes in the last few years. Due to these changes, I have been compelled to indulge into the use technology in the education process to facilitate dealing with the curriculum effectively and to deliver the information to students in a simple way.*

Teacher three answered:

> *Yes, I made the decision to draw on the technology when educating my students because technology has grown to be a fundamental part of our daily life and students have an outside classroom experience with technology. By integrating the use of technology education, it is possible to engage students' interest in a subject*

and as a result, they will be able to receive more information during learning mathematics.

It is clear as they mentioned above in the definition of mathematics education technology. Teacher one, two and three gave us a clear picture of the meaning of technology which all agreed upon an array of tools including computers, Interactive Whiteboard, projector television and video used for the purpose of improving the quality of teaching and learning mathematics. And in regard to the answer of question one, all three teachers answers to the first part of the question are yes. However, they provided three different reasons on their decisions to use technology. Teacher one mentioned that with the extremely rapid technological growth in our life, educators can take advantage of the use of technology with their students, to promote teaching and learning mathematics. While teacher two answered that, he tried many strategies to simplify the task of mathematics, but found the technology as a good way to make the understanding of complex mathematical operations easier. In addition, the national curriculum in the Saudi public education system is developed, which made technology an integral part of it, forcing him to use the technology keep pace with this change in mathematics subject. Teacher three illustrated that students live in technology outside the classroom. In this mind, by integrating the use of technology education, the students will be more enthusiastic to learn mathematics.

2- What are the types of technology you use with those students? Why do you use those items?

All three teachers have experience with the same type of technology, which is interactive whiteboard. However, each teacher used it in the different way depending on his students, because IWB gives teachers the opportunity to be used in a variety of different ways within the class room.

Teacher one goes to mathematics laboratory most lessons with his students, having 20 computers connected to internet and one computer for teacher, one colour printer, Interactive whiteboards and a projection system used to display sample programs and materials. He added:

First of all I would like to give the reader what I mean by Interactive whiteboards? How does it work? What does it do? Why I use it? Is how I use the board in my lessons more important? An interactive whiteboard is an

> *instructional tool that is connected to a computer and projector, which consisting of a large touch-sensitive that allows the teacher manipulate the elements on the board through the use of either special pens or fingertips directly on the screen, this is utilized instead of the mouse. I have been using the electronic interactive whiteboard for two reasons. The first reason is that I know the effect of interactive whiteboard technology on students who have difficulties in mathematics. Therefore, I became interested to use this tool in helping my students overcome the difficulties they have in mathematics. Secondly, the device combines many features and characteristics in one tool. These includes: displaying all sorts of information in an interesting format, with the ability to interact with the information that is being shown such as highlight text to draw attention to specific parts of a lesson, I can easily record the lesson by saving and reopen it to the students who were absent from a lesson to review or re-explain the lessons missed. In addition, it shows pictures and educational videos of which I can pause at a certain point for discussion and brainstorming*.

Moving to teacher two who also used Interactive Whiteboard with his students.

> *I used IWB with my students, and as I know you will observe me in my class to see and know more concerning how I use the Interactive whiteboards in my lessons. However, if you as ask me what is IWB and why I chose it, I can say that the IWB is a tool with a computer interface, it helps to display the images on the computer over the Board. Basically, computer, projector and an interactive board are the three main components of the IWBs system. If the computer and the data projector are not available, the IWB could not be used. These two systems are connected to each other through two cables. The first cable connects the projector and the computer, while the Board and the computer are connected by the second, which is the series cable. The reasons of using this tool is because an IWB provides multimedia presentations, several visualizations, which we can use all benefit from and more in classroom environments where mathematics is taught, in order to develop particular concepts and also enhance overall knowledge of the subject.*

Teacher three answered me on above question with pride and pride as follow:

> *I used interactive whiteboards with my students who have difficulties in mathematics, this tool has rapidly become popular in numerous classrooms*

around the world. The IWB is a multipurpose tool that represents a combination of a number of technologies in one device, including whiteboard; DVD player, slide projector etc. These are all among several recognized classroom technologies. This combination will add excitement and enthusiasm in classrooms where students are learning from this teaching method. Therefore, my reason for using this tool especially, as my head teacher gave me a chance to attended a training course on the use of smart blackboard with students who have difficulties in mathematics. This made me use this technology especially effectively after being taken through the full advantages of the potentials provided by this technology. I also do not want to forget to comment on the reward provided by the head teacher that has also had a significant impact upon me. This is when I look at the IWB and directly remember the reward, and want to "give back" to the head teacher who encouraged me to use this technology.

3- Does the technology help you cover the key mathematics concepts in the syllabus?

All three teachers answered yes, and they pointed out that after the development of mathematics curriculum by the Ministry of Education, technology has become an integral part of the curriculum. In addition, the King Abdullah Bin Abdulaziz Public Education Development Project (Tatweer) purposes to improve results of education in the Saudi Kingdom via enhancing the use of technology. There are broader education reforms in Saudi Arabia, and this project is one of its parts, which also lead to elevate the position of the Saudi Arabia between developed countries in education.

All these helped the three teachers who utilize technology in all areas of mathematics with confidence. Teacher one added:

I would like to give the reader a clear picture of the King Abdullah Bin Abdulaziz Public Education Development Project (Tatweer), it is a Saudi based company which offers educational services. It works with the Ministry of Education to develop the educational system, focusing on areas such as the development of Science, Technology, Engineering, Mathematics, Computer Education, Arabic and the English language teaching program.

Teacher two and three agreed with same point that, before development of mathematics curriculum by the Ministry of Education, it was difficult for them to cover the all mathematics topics in the syllabus through the use of technology in the structure of some topics at the pervious mathematics curriculum as, it did not help them find appropriate ways to present the lesson by using technology. However, after development of curriculum, they can take advantage of technology with those students who have difficulties, as the way of structuring the lesson is changed to include technology as an integral part.

From the previous responses of the teachers to above question, I find that all three mathematics teachers agreed that technology helped them cover the all key mathematical concepts in the syllabus, after the new development of mathematics curriculum. However, teacher two and three have an interesting point, that, before this development they could not cover all concept of mathematics through the use technology, because the structure of some topics led to difficulties in finding a way to use it with the technology.

4- Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?

The table above shows that all three teachers were in agreement regarding how technology helps students who have difficulties in mathematics. However, they gave different views when asked them concerning how an interactive whiteboard help those learners to learn.

Teacher one mentioned that the use of IWB draws student's attention and increases their motivation towards learning mathematics especially the concept of multiplication. As a result, I asked this teacher for the evidence to support the point. He showed me the students' report before the use of the IWB and after using it which shows that their grades have increased upon the use of such technology (Actually he showed me two exams for evaluating the students' performance in mathematics, In one of these exams which he had sat previously, he used technology and also another after using technology. Each exam includes several types of question such as true-false and multiple-choice). The results from the report contribute to the belief that the use of IWB attracts students to be continually interested in the lesson, or as this teacher said:

The function of interactive whiteboard in mathematics education is to boost the motivation and aptitude of students who experience difficulties in working mathematical problems.

He added:

I can also prove to readers that the IWB had a positive influence on student's motivation to learn new concept of mathematics, when I started my work as teacher at one of the primary schools there was not technology available in the school I taught in, where I had a class consisting of 20 students and some of them had difficulties in learning mathematics. At that time I used traditional methods to teach them mathematics. This means without technology. When the Ministry of Education began to integrate the IWB into schools, I learnt the basics of using this tool and tried to use it with my students. Indeed, I noticed improvements in the students' motivation after using the IWB.

Teacher two mentioned to me before answering the above question that he preferred to move with his students from year one to year six. Because he believed that the first six years of a student life in school are a particularly sensitive period in learning and teaching mathematics. Therefore, when he is teaching these students from the first stage of education to the sixth stage, it will give him the opportunity for early intervention using the interactive whiteboard to avoid the persistence of negative results in the coming years. For example, he taught these students from year one to current year in year four. He added:

To answer your question, I will link the effect of early intervention with how IWB can help learners to learn mathematics, through this example. Some of my students faced mathematics anxiety when they were at year one that can impaired their development in mathematics. I asked those students individual the reasons behind their anxiety, which appeared to me that some of them were punished by their parents for failing to master a mathematical concept or being embarrassed in front of a sibling when failing to correctly complete a mathematics problem. And some others mentioned that before they begun the school, their family warning them of mathematics in terms of the difficulty and need to give more effort in order to succeed, this led to increased concern of mathematics and resulted to failure in mathematics.

By linking the effect of early intervention with how IWB can help students to learn mathematics. He added:

> *The importance of early intervention with those students who have difficulty learning mathematics with the involvement of technology in this intervention, will benefit the students by reducing and eliminating the adverse results for students who experience mathematical difficulties, because this tool will make this subject more easy and entertaining.*

Teacher three pointed out that some of my students have less confidence about learning mathematics, particularly when studying concepts of multiplication, which may result in a reduced interest into continuing mathematical studies. Self-confidence has a crucial role since students with high levels of confidence often score well in their tasks. As a result, students with low confidence require the teachers to help them with mathematics topics. As a result, he tried many strategies and found that IWB can enhance students' confidence toward mathematics. In addition, some of his students have difficulties in remembering basic mathematical facts. They usually learn a section of the table of multiplication today and forget the same information the following day since performing such mental calculations in the students` head requires much of their working memory. Basically, students who do not have difficulties in mathematics often are able to save the heard information, retrieve it and use it when required. On the other hand, the students with poor working memories are not able to recall that information, as it lost. He added:

> *In order to determine changes in confidence toward mathematics and the improvement in the students' memory as a result of IWB intervention at the previous year, I tried to notice the effects of IWB on students, with a focus on enhancing confidence in mathematics and help children who struggle with working memory and mathematics. I also tried to apply that experience with these students in this year and found that the IWB approach lead to realization of substantial improvements on their memory and confidence in mathematics. I will show you your note during the classroom time that is, how this experiment works with those students to see that technology's role the education of mathematics is to give meanings to numbers, to enhance students' confidence and to aid in boosting the memory of the students.*

I understand from the above answers that all three teachers agreed that technology can help students with mathematics difficulties to learn. However, when I asked them how technology can help the learners to learn, each teacher is different from other. Teacher one mentioned his experience with the IWB; he noticed it boosted the motivation of his students who had difficulties in mathematics. On the other hand, teacher two revealed a reduction in motivation and eliminating poor results. Finally, teacher three reported that to provide numbers with meanings, enhances the confidence of students and aids in improving the students' memory.

5- Have you learnt anything new by using technology in your class?

The table above shows that all three teachers learnt how they use interactive Whiteboard with students who struggle with mathematics, where this course takes place inside the school. The main goal for taking this course was to ensure that they are able to exploit all of the features of interactive whiteboard technology during use with those students who have difficulties in mathematics, which was taught by qualified and experienced teachers and trainers. When they finished a training session which lasted about two days, they were given a certificate showing that they have successfully completed this course.

I asked each teacher, why they chose especially this technology which Interactive Whiteboard, when they decided to attend a training course. Teacher one answered:

> *I choose this because the electronic interactive whiteboard is a device that combines a variety of uses which can be adapted for use with all lessons in mathematics and all levels at primary school.*

While teacher two said:

> *Interactive whiteboards are an increasingly popular choice in primary schools in Saudi Arabia, and most mathematics teachers use them for different purposes. As a result, I only have this technology in my classroom; I want to ensure that I gain the most out of the technology.*

Moving to teacher three:

> *I choose this technology for two reasons; the first is that I can put a variety of strategies and techniques into practice using IWB. The second is currently and as*

you see, I have this tool in my class, here comes to the role of the teacher in how to take advantage of this technology in all areas of mathematics.

It is clear that all three mathematics attended a course entitled how teachers use interactive Whiteboard with students who struggle with mathematics. The main objective of the attending of this session is to take advantage of all the advantages of smart board use and how to use it with the students who suffer from mathematics. In addition, each teacher has different reason in using this technology to be trained. Teacher one said he can use variety of tools in one device to achieve the goals of lesson. While teacher two mentioned that this technology is largely available in primary schools in Saudi Arabia, and he has one in his classroom, which led him to take advantage of all the services offered by this technology. Teacher three combining the first and second reasons cited by teacher one and two.

6- What are the main reasons behind the decision of the mathematics teacher to not use technology to help students with mathematics difficulties? (Teachers themselves, school, government).

According to the interviewees, there were reasons behind the decision of the mathematics teacher to not use technology with their students, which goes back to the teachers themselves and the school. Teacher one put the reason in school only which he stated:

Although schools may have IWB available, one factor that influences teachers' decision of using it is where those IWB are located. In other words, keeping the IWB in one place in school will hinder and prevent constant use by the teacher. As a result, teacher may make a decision to leave this tool as the availability will be limited and then students don't benefit greatly from technology as the teacher will not cover all the areas of mathematics with technology.

I asked him if all schools have a limited number of technologies despite the Ministry of Education in the Kingdom being keen on the distribution of technology to schools, which are supported by the Saudi government continuously. He answered:

I think you asked me a good question, and I would like to be clear. The Ministry of Education distributes smart boards gradually in schools, and then if there is any *lack of IWB in any school, the school principal has to write a report on the amount of interactive blackboards they need in their school.*

Teacher two answers to above question, centered on teachers themselves and school. As a result, I asked him what he meant by teacher themselves and school? He explored:

Teacher's negative attitudes towards computers affect their decision of the using it in classroom. For example, when some mathematics teachers initiate computer activities in their classroom and feel low confidence level during the use in front of their students. This feeling led to anxiety towards the use of computer, which often results in negative attitudes. At the end, the negative attitudes influence the decision of the mathematics teacher to not use technology to help students with mathematics difficulties.

He added:

In regard to school, the school administrator plays an important role in the teacher's decision to use technology. For example, if the leaders are not giving the teachers any backing or encouragement to utilise technology.This cannot help them ensure that the use of technology is prioritized. As a result, teachers will feel uncomfortable in trying to use the technology, and then influence the decisions of teachers.

Moving to Teacher three who believed that the school only was behind the decision of those teachers who do not use technology with their students. He stated:

I would like to explain why I chose school only and not the teachers. Because some people criticize teachers only, that he/she is the only reason behind not using technology in his class. This is regardless of the role of school administrators as a reason like the head teacher who plays a big role in setting the climate of a building. For example, I know two teachers who don't use technology in schools at all. However, when they sense a positive attitude on their head teacher, they rethink about their decision to not use technology; as a result, they now use technology with their students.

I can see from above that teacher one and three agreed that the main reasons behind the decision of the mathematics teacher to not use technology to help students with mathematics difficulties is school only. While teacher two defied the reason behind this blaming teachers themselves and school.

7- What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of (Training teachers to use technology? Technical support? Teacher attitudes and beliefs about teaching mathematics with technology?

According to teacher one, he thinks the major obstacle facing teachers when using technology with those students who have mathematics, is dependent primarily on the attitude of teachers towards the use of technology and that this determines the level to which technologies are to be applied in teaching and learning processes.

He believes that if teachers have a positive attitude regarding the use of the Interactive Whiteboard for the aims of education, then they will use it in class. However, if teachers have a negative attitude regarding the use of IWB, such as believing that the Interactive Whiteboard does not encourage teachers to use discussion methods with their students, which leads to lack of collaborative exchange of ideas among a teacher and students. In addition, some others may believe that the lack of time during class does not allow them to use technology effectively. Moreover, some may believe that there is no technology available when they study at University. As a result, they will prefer to teach their students without technology, as they have no idea about technology. This indicates that there is a relationship between the use of IWB and the attitudes among teachers.

Moving to teacher two who gave me a clear picture that the major obstacle facing mathematics teachers when using IWB with their students is the lack of training. Clearly, IWB will not boost studying mathematics except for the teachers who are trained as to the suitable use of the technology. Consequently, teachers who have been trained effectively in the use of technology, and have enough expertise and skills in the utilization of computers, will have a positive impact on their students' progress. He also mentioned that this school has few teachers who during their studies at University were not trained to apply IWB in the classroom, but as those teachers understand that for students with learning problems using IWB can very effective, hence they try using technology for teaching their students.

He also mentioned that when he was at a previous school, he found one of the teachers who was inexperienced with technology and lacked sufficient knowledge on how to set up technological devices. This led to constant interruptions during the lesson, and resulted in discomfort with using technology for teaching and learning. This clearly shows the key function tutors have in enhancing the operation and efficiency of technology after undergoing the necessary tutoring.

Teacher three believes that the major obstacle facing teachers when using technology with those students who have mathematics difficulties is the lack of technical support. According to him, disruptions are caused by the crashing of a computer and repairs done regularly in the computer will not be performed if there lies technical assistance absence. As a result, teachers would not use computers for teaching purpose. Moreover, due to equipment failure fear the teachers would be discouraged and may not use computers as case there is technical problem then there will be lack of technical support. He added:

> *A strong association is made between technical assistance and obstacles to the use of technology in classrooms. The obstacles here include: if teachers know that there is no one for offering immediate technical support, then teachers will be discouraged from using technology.*

The breakdown of equipment, not to mention the issues of complexity, high risk of losing data, embarrassments and stress were all quite difficult for him to resolve. He asked himself: what shall I do in front of 35 students if the computer suddenly does not work and there is no direct aid? Therefore, the prevalent utilization of technology in classrooms can only be achieved if there is a provision for technical assistance and maintenance when required. Otherwise, the tutors could easily disregard requirement to integrate technology, as they will waste too much time postponing their classes and awaiting a tangible solution to the technical problems.

From above answers I can see the message that those three teachers respectively want to send to us is as follows, the main major obstacle facing teachers when using technology with those students who have mathematics difficulties are: teacher attitudes and beliefs about teaching mathematics with technology, training teachers and technical support. However, by addressing all these factors, I can make sure that the educational technology in the classroom is used effectively. Through such efforts, schools can help teachers through the use of technology to enhance teaching and learning mathematics.

8- Do you need any further support to use technology, and if so, what support do you need?

All three teachers felt no need for any further support to use technology, because the principals of their school encourage them to overcome any obstacles they face during their use of IWBs. They agree that the availability of technology in schools is no longer the issue in education in the Kingdom of Saudi Arabia, as the ministry of Saudi has a great financial support from government to provide the necessary technology in schools. However, the current emphasis lies in ensuring that teachers can use this technology as an effectively way in teaching. As a result, this need simply leads to training teachers to keep up to date with all new technologies to promote learning for all students in the classroom.

Moving to the responses of three teachers who used technology, on the second part of the interview questions (see table 5.2).

Questions	Teacher one	Teacher two	Teacher three
1- Why did you decide to use/not use technology for this lesson with students who have mathematics difficulties?	Multiplication facts and skills are imparted on students in the third grade but each year, a number of students enter the sixth grade having not learned these multiplication facts. This has led to a lack of the fluency by students required to advance to the more intricate mathematical concepts in the curriculum of the sixth grade. An example of a multiplication fact learned in the third	My students have difficulty with subtraction for three reasons. First, they have a misconception from about addition. Secondly, they fail to understand place value and, finally, the use of faulty procedures when solving subtraction problems. However, the problem can be solved by IWB in that it improves students' comprehension. IWB helps students to connect with new information, making use of their previous knowledge, their	I utilized the Number Race program and PowerPoint presentation through Interactive Whiteboards to conduct this lesson (multiplication facts) because it provides a unique platform for making presentations, thus enabling the audiences to concentrate more on the screen than the speaker, and this helps in reinforcing the message. This is because students learn better when

	grade is that multiplying any number by zero equals zero. I, however, observed that some students in the sixth grade were not familiar with this concept, I think one of the reasons why they may not learn multiplication in a more interesting way is that by not using technology may lead them not to remember this concept. I always use technology with lessons. However, I am keen to use technology in this lesson, particularly to ensure students do not continue to lag behind in mathematics throughout middle school.	ability to reach conclusions and create interpretations of the texts which, in turn, improves comprehension capability.	words are integrated with illustrations than when words are used alone.
2- Is technology used to increase basic skills, to make the understanding of complex mathematical operations easier or as a resource to entertain students?	I think for both, to provide a better understanding of complex mathematical operations and as a resource to entertain students.	To ensure a better understanding of complex mathematical operations and as a resource to entertain students.	Both of them.
3- How often do you use technology when teaching	Every single lesson.	Daily.	Daily.

students with mathematics difficulties?			
4- Where do you usually get your ideas from for using technology? (Magazines, colleagues, workshops, technology coordinator, Internet, by yourself, etc.)	By himself.	By himself and the Internet.	By himself and some of his colleagues.
5- Did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe? If not, how did you overcome the problem of training?	Yes. However, it is not enough for me, so I attended various training courses away from the university.	Yes, I attended various training courses, which has helped me to understand computer systems at a deeper level and be able to help students who find it difficult to learn mathematics. Beyond classroom responsibilities, I used every opportunity I received to gain expertise in computing and the ability to solve complex and challenging problems. As a result, I can help my students with mathematics through technology.	I attended various training courses, which was designed to provide further academic and professional training in computer science for those teachers who want to gain skills and knowledge about technology field.
6- If offered, how likely would you be to participate in technology training either during or after school time?	I will participate in this session and I will also encourage all my colleagues to be present.	With pleasure.	I prefer to do this during school time because I do not have available time after school. However, either during or after school, I am enthusiastic to learn new

			information to help my students.
7- If no, what factors may have led you to not attend training sessions?	-	-	-
8- What is needed to make the necessary teacher training work?	Head teachers are ultimately responsible for making the necessary teacher training effective by using incentives to motivate teachers, following up on new technology and incorporating it in the classroom.	The directors of the schools plays an important role in making the necessary teacher training effective, by allocating a part of the teachers' evaluation to regular attendance at training courses.	Reduce the burden of additional requirements on teachers, but with the condition that attending training courses is seen as a reward from the school directors.
9- If you wanted a technical support in your class but it is not available in the school right now, how would you overcome this problem?	These teachers said that the school director was allocated a part of the budget to help them when they need support for technical. This head teacher tries to remove the obstacles in front of teachers' in order to help them to continue using technology without stopping as they said.		
10- How can we overcome the negative attitude of teachers towards the use of technology?	In my opinion, I will ask this teacher to attend a lesson with a faculty member who uses technology, in order to see its positive impact on students	We should provide them with appropriate training that includes opportunities to explore new technologies and practical ways of obtaining support and guidance in using them.	The teachers should have trainers who guide them through active participation instead of just giving verbal instructions.

Table 5.2: The responses of three teachers who used technology on the second part of the interview questions

1- Why did you decide to use/not use technology for this lesson with students who have mathematics difficulties?

Teacher one pointed out that multiplication facts and skills are imparted on students in the third grade but each year, a number of students enter sixth grade having not learned these facts. This has leads to the students' lack of the fluency required in the learning the more intricate mathematical concepts in the mathematics curriculum during the sixth grade. An example of a multiplication fact learned in the third grade is that multiplying any number by zero equals zero. He added:

> *I however observed that some students in the sixth grade were not familiar with this concept and, I think one of the reasons why they may not learn multiplication in a more interesting way is that by not using technology may lead them not to remember this concept. I always use technology with lessons. However, I am more and more keen to use technology in this lesson, particularly to ensure students do not continue to lag behind in mathematics throughout middle school.*

Teacher two adds an interesting point as his students have difficulty with subtraction; let us see what he said:

> *My students have difficulty subtraction because of three reasons. First, they have the problem because of the misconception of over generalization from addition. Secondly, they fail to understand place value and, finally, they use faulty procedures when solving subtraction problems. However, the problem can be solved by IWB because it improves the student's comprehension. IWB helps students to connect with new information, make use of their previous knowledge make conclusions and create interpretations of the texts which in turn improve comprehension capability.*

Teacher three decided to use technology for this lesson with students who have mathematics difficulties because:

> *I utilized the Number Race program and PowerPoint presentation through Interactive Whiteboards to conduct this lesson (multiplication facts) because it provides a unique platform for making presentations thus, making the audience concentrate more on the screen rather than the speaker which helps in reinforcing*

the message. This is because students learn better when words are integrated with illustrations than when words are used alone.

To sum up, teacher one reported that the reason for use IWB in this lesson is to ensure that not continuation of the same difficulties with those students after the transition to middle school. Teacher two pointed that to connect with new information, make use of previous knowledge to make conclusions and for elucidation of the texts that improves the ability to comprehend, students are much benefited by IWB. While teacher three also emphasized on the use of IWB grabs the concentration and attention of the student toward the display rather than the teacher in order to enhance comprehension. This is due to the fact that learning is made more interesting with pictures and words as compared to solely utilizing words.

2- Is technology used to increase basic skills, to make the understanding of complex mathematical operations easier or as a resource to entertain students?

Teacher one answered the above question, as he thinks for both, to provide a better understanding of complex mathematical operations and as a resource to entertain students. As a result, I asked him how in both cases? He added:

As we know mathematics difficult for some students in this school. However, it has important applications and many uses in life such as reading an odometer, doing business, counting change and many others. Therefore, engaging students through entertainment technology to make the understanding of complex mathematical operations easier will help those students to look at mathematics as an easy subject, and then help them deal with the numbers in the future. As a result, I used IWB for increasing fundamental skills, to make difficult mathematical operations simpler as well using it as a resource for entertaining students.

Teacher two mentioned that he used IWB to simultaneously make learning entertaining and foster the comprehension of complex operations in mathematics. Because the students in primary school cannot learn mathematics without fun. He added:

I was surprised when my colleague told me in the previous school that he only uses technology to entertain the students without access to the objectives of the lesson causing this teacher to stop the use of technology with his students. This is because he felt that the use did not improve the performance of students in *mathematics. Then, I met with the teacher to ask him if he wanted to continue using technology in the right way, he should use technology for both reasons. This means that he can use fun technology to reach the lesson goals. Because, when the students see the technology in class, they know that it is for entertainment. However, the role of an ideal teacher will appear, when the teacher uses this technology to simplify the mathematics tasks.*

Turning to teacher three who puts a close relationship between the technology used by students in their homes for entertainment, fun and enjoyment; and the technology he uses in the classroom, where he tried to use programs that also provide fun but without ignoring the lesson objectives. He pointed out,

In this class, some students have difficulty in mathematics, and we know that students live in technology outside the classroom, and they use it to entertain themselves. Therefore, I always use IWB with programs that entertain students in the classroom, but with the achievement of the objectives of the lesson and to make the understanding of complex mathematical operations easier. In addition, I follow constantly know what software and applications and devices used commonly by students in their homes. "I know you will ask me now why, and the answer is simply trying to use the same ideas of these games with mathematics lesson." As a result, students will be more willing and enthusiastic to learn mathematics.

It is interesting to say that the teachers agreed that the use of technology is meant to increase basic skills, to make the understanding of complex mathematical operations easier and as a resource to entertain students.

3- How often do you use technology when teaching students with mathematics difficulties?

Teacher one pointed out that he has been used the IWB every single lesson. He added:

I know that in this school the teachers who have started using technological tools in their daily routine have a common concern and that is the time needed for planning and incorporating these tools in their daily lessons. Teachers believe that in adopting such equipment, much of their existing lesson plans have to be rewritten, however, these beliefs are but misconceptions.

I asked him how do they address this misconception? He mentioned that this can only be possible if those teachers changed their view of technology to be seen as a supplement rather than a substitution of ideal teaching as a practice.

While teacher two answered to the third question as follow, he used the technology in his classroom every day to help those students with difficulties in mathematics. I asked him how we can help new mathematics teachers use technology with their students every day lessons. He answered:

> *To be successful and significant, the use of technology must become part of the everyday practices. To help those new mathematics teachers to use technology regular routine in the classroom, they have to know that students must be made very clear that using computers, interactive whiteboards and other tools and software are not some sort of reward or special event that has to be earned by them. In fact, students must see technology similar to other equipments of learning for example textbooks, pencils.*

Moving to the teacher three who also used the technology daily. He reported that; as a teacher, he cannot miss the opportunity of developing the mathematics curriculum in the Kingdom of Saudi Arabia, because after the development he used the technology every day and with each lesson. He added:

> *However, before the development, I begun the implementation of technology slowly at first, but cannot use technology in some lessons, which makes me not use technology daily. In other words, new development in mathematics curriculum gave me a huge boost with the enthusiasm to be used a daily basis with those students who have learning difficulties. That does not mean I did not try to use technology daily before the development of the curriculum, because I believe that teaching mathematics with technology is very important.*

I can see from above answers of the third question that all three teachers have used technology every day with their students. However, each one mentioned the way that helped him in the use of technology every classroom time, and want from new mathematics teachers to benefit from these point. These included respectively, the idea that technology supplements the teaching practice rather than replacing it. The second teacher emphasized on the utilization of computers and other tools being seen as an aid to learning rather than a privilege or special occurrence. Teacher three said an interesting point, that new development in mathematics gave him a huge boost with the enthusiasm to be used a daily with those students who have learning difficulties. That does not mean he did not try to use technology daily before the development of the curriculum, because he believes that teaching mathematics with technology is very important.

4- Where do you usually get your ideas from for using technology? (Magazines, colleagues, workshops, technology coordinator, Internet, etc.)

Starting with teacher one who usually gets his ideas from using IWB by himself.

> *Variety is the spice of life and every good teacher knows that you have to use a different set of ideas and use it with technology to help all the different individual needs of students. I usually use brainstorming as a tool to find out appropriate ideas that can be used with Interactive Whiteboard to help students who have difficulties in mathematics by fulfilling the requirement of the students, which includes assessing prior knowledge and increasing the learning rate.*

For the second teacher, he usually gets the ideas for using technology to help those students from himself and the internet. He added:

> *I usually relied on myself to innovate new ideas by technology to serve these students to overcome the difficulties. However, sometimes I surf some sites in order to benefit from the experiences of mathematics teachers. There are many sites on mathematics education though technology does a good job in pulling together information from ideal mathematics teachers in this city. I benefited from these sites on two sides; the first includes the exchange of knowledge on how the tutors can enhance the system of learning to provide an ideal learning experience for the students. Secondly, sharing advice on the new ideas that can be used with technology to assist students with difficulties.*

While teacher three pointed out:

> *I think it is a good question; I try to create the ideas by myself to help me deal with all these students needs. I mean by create ideas by myself when I use technology to take advantage of applications and programs that are already*

> *provided by Interactive whiteboard and combine them with my thoughts to help students who suffer from mathematics difficulties. All the programs offered by IWB will be useless unless teacher put his ideas to be used optimal and efficient use. To be honest with you, sometimes we share our experience and ideas with some of my colleagues at school which transmits enthusiasm among ourselves in the continuation of the use of technology, and this is one of the goals of the school principal.*

After looking at all the answers, it can be concluded that the three teachers rely on themselves to get suitable ideas for their students in the use of technology. However, I find that the second and third teacher additionally rely on themselves, sometimes the second teacher surfs the web sites to share advice about how teachers can work in accordance to enhance the education system to help students with difficulties. This would allow the teachers in offering the best learning experience to their students and sharing of advices about the new concepts that can be used with technology so as to solve the problems of students. While the third teacher, he shares experiences and ideas with some colleagues to benefit from each other.

5- Did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe? If not, how did you overcome the problem of training?

Teacher one said:

> *The answer is yes, however, it is not enough for me, therefore, I overcame the problem of training, through attending various training courses including 'The Use of Technology in Mathematics Education', 'Towards Technology Integration in Mathematics Education', and 'The role of Technology in Teaching and Learning Mathematics'. All those courses took place at different periods of school time.*

While teacher two mentioned that:

> *As you know, I attended various training courses that enabled me to understand the systems of computer at a deeper level and I was able to help students who faced difficulty in learning mathematics. Moreover, for gaining expertise in computing and the capability in solving difficult and challenging problems, I used*

every opportunity I received after school time. Thus, by learning new technology I not only was able to get a hike in my salary but also was able to help my students with mathematics by applying technology.

Moving to teacher three who pointed out:

No, I attended various training courses, which was designed to provide further academic and professional training in computer science for those teachers who want to gain skills and knowledge about technology field. For example, before I attended this course, I only knew that Word processing software is used for typing Text only, but after finishing the course, I knew the role of this software in mathematics.

From above answers show that teacher one and two their college education included learning activities on how to use technology for teaching students. In this regard, although, teacher three's college education not included any learning activities on how to use technology for teaching those students, he tried to overcome this issue by attending training to support him in using technology effectively.

6- If offered, how likely would you be to participate in technology training either during or after school time?

Teacher one pointed out that certain technologies such as computers and software updating are changing constantly, therefore, teachers need ongoing training to keep up with the rapid development of technology. He added:

I am extremely likely to participate in this session and I will also encourage all my colleagues to be present: because in developing the understanding of the technology and its value the teachers must derive knowledge from continuing learning opportunities. As the technology advances, they must realize that it would benefit them personally and professionally. Teachers must obtain the various advantages that the technology offers not only for them but also for our students' learning and for their futures.

Moving to teacher two who answered the above question as follows:

The teacher's primary role is to help students understand particular subject matter. Everything else is secondary. Therefore, with pleasure I will participate in *technology training either during or after school time. I would like to know how computers improve the performance of a teacher and their work. What impact it will put on the core areas of the teacher's duties, to support the lesson objectives? How will they choose the most suitable technologies? How will these instructional goals be supported, by which technologies? For achieving the desired goals, how can technology be used with other learning tools? The focus of training program should not be only on the technology but also on the questions I just mentioned. If the training did not include these questions I will apologize for attendance because it will waste my time.*

In regard teacher three, he pointed out that:

I would prefer this during school time because; I do not have time after school. However, either during or after school, I am enthusiastic to learn new information to help my students. Because the school principal encourages teachers here to learn and follow-up any new technology, and use it with these students. Believe me, I love technology, but these factors will help me and my colleagues to continue using the technology without dampening. We teachers like students also need to encourage and promote, which will be reflected in our performance with the students.

I can see from above, all teachers are excited to attend any training program provided to them, because the first teacher feels that technology is constantly changing and will need these trainings to keep up to date with information and skills. While the second teacher will be more enthusiastic if training is not on the technology itself, but on how computers can improve performance in these core areas of the teacher's job and students' achievements. Also, the third teacher will attend the training session to learn new information on technology to help his students, as his head teacher always encouraged him to keep track of developments in technology and use them to help students, and this is one of the factors that made him eager to attend.

With regard to the next question of my interview questions, "If no, what factors may have led you to not attend training sessions?" I did not ask these three teachers this question because this question seemed to be based on their answers to the previous question where all the answers were yes. However, teacher two and three try to include their answer in previous question in this question. Therefore, I will move to question eight.

8- What is needed to make the necessary teacher training work?

Teacher one pointed out that it is important and necessary to have a good head teacher for motivating as well as for evaluating teacher performance as well as setting up objectives. He added:

> *Although mathematics teachers of which I am one in this school with many years' experience, we know the role of technology or to be more specific Interactive Whiteboard on mathematics education and understand the importance of training sessions. But in all honesty, our head teacher has the positive effect to make the necessary teacher training work in this school. Therefore, I will answer your question by saying, head teachers are ultimately responsible for making the necessary teacher training work, by using incentives to motivate teachers, and follow-up of new technology as incorporated in the classroom. Generally, the large proportion of the head teacher's duties include effective administration and regulation of the school to create an optimum learning environment.*

In regard on teacher two who also focused on the head teachers in terms of their direct impact on teacher training.

> *The Ministry of Education ask all school head teachers to provide them with a comprehensive assessment of all teachers in his or her school, and this assessment of 100 degrees. The criteria for evaluating teachers often consists of quality of teaching, contribution to development and regular attendance in school. These standards directly affect the teachers in terms of promotion at Position and moving from school to school favored by the teacher. I think if the head teachers allocate a part of the teachers' evaluation degree to attending training without absence, they will make all the teachers keen to attend this training to earn big scores.*

The third teacher added an interesting point which made its axis in the head teacher. He added:

> *As you know that primary teachers in the Kingdom of Saudi Arabia will typically work between the hours of 7.15 AM and 1.00PM, from Sunday to Thursday. Actual teaching time amounts to 20-24 teaching sessions per week. Teaching hours in Saudi Arabia may vary by school. There are additional burdens on teachers such as covering teachers' absence, supervising the students during their entry, lunch break and exit from school. It is usually the responsibility of the principal to prepare the duty roster and ensure that each day two or three of these teachers must do this work. However, the head teachers can form relation between these burdens and regular attendance for training to use technology, that the teacher who attends training sessions will reduce or delete this burden depends on the amount of attendance for training. Therefore, you will see that most teachers are racing to attend these trainings to take advantage of two things, including increasing their knowledge about the use of technology and a reduction in the daily burdens, which help them to provide more and more of their energy to students inside classrooms.*

I can see from line to line that all three teachers who use technology with their students, made their focus on school principal upon being asked them the needs that enhance making the necessary teacher training work. They send the message that the director of the school plays an important role in making the necessary teacher training work. By stimulating teachers, they should add a new standard when evaluating teachers inclusive of regular attendance to training courses, which it makes a great degree of evaluation in this standard. While the third teacher pointed out that through reducing the burden of additional work on teachers, with the condition that they attend training courses.

9- If you wanted a technical support in your class but it is not available in the school right now, how would you overcome this problem?

It is interesting that all three teachers gave the same answers to this question. From question six to this question, I understood from these teachers and that their head teacher has a positive effect on them, although there are some common core elements between different schools, their head teacher is a unique. This proved more when they answered to this question.

They said that usually the system here in Saudi Arabia through the Ministry of Education gives each school principal a budget for the operation of the school; and the amount of budget depends on the type and size of school. All school principal use this budget by the school needs to ensure they motivate teachers and students to continue education as required.

Return to the answer to question above, these teachers said that the school director was allocated a part of the budget to help them when they need support for technical emergency. The first and second teachers added that their head teacher has mastered the disposition of the use the budget made him unique, as he ensured they did not hear this term at all "it is not available in the school''. This head teacher tries to remove the obstacles in front of teachers' in order to help them to continue using technology without stopping as they said.

10- How can we overcome the negative attitude of teachers towards the use of technology?

Teacher one gave us an important suggestion to help those teachers with negative attitude towards the use of technology. He pointed out:

> *In my opinion, I will ask this teacher to attend a lesson with a teacher who uses technology, in order to see the positive impact of technology on students himself.*

Moving to teacher two who also add an interesting point to overcome the negative attitude:

> *If we need to help teachers to overcome the negative attitude towards the use of technology training, we should provide appropriate training for them, not only with opportunities to explore new technologies but also practical ways to obtain support and guidance in using them.*

While teacher three responded to above question in a manner that is close to the answer of the second teacher.

> *The teachers should also have trainers who train them through active participation instead of just giving verbal information of what should be done.*

From above I can conclude that teacher two and three centered their answers on one point that when helping the teacher with negative attitudes towards the use of technology; we should provide him appropriate training to focus on practice. Teacher one who is slightly different from their answer, suggest that he will ask the teacher who has a negative attitude to go for a class with an instructor who utilizes technology to realize the advantage of technology as a teaching and learning aid.

The following are the responses of three teachers who did not use technology, on the first part of the interview questions (see table 5.3).

Questions	Teacher four	Teacher five	Teacher six
1- Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology?	No, since I have no idea how to use technology in class for mathematics lessons, and, thus, I have not tried to surmount this obstacle, because I need more encouragement in place in order to receive the required training and thereby demonstrate innovative teaching. As such, I did not decide to use technology, although I understand the positive impact of IWB on learning amongst students who have difficulties in mathematics. As a result, I might change my mind if there is support and encourage the use of technology.	No, the reason for the non-use of technology is because we need more support from the Principal to remove the obstacles we face, such as providing technology, appropriate training and technical support.	No, from his experience he found there are relationships between age factor, in-service training of the head teachers and the principal's facilitating efforts towards integrating technology in schools and encouraging their staff to use it. Whatever progress a headmaster makes in a lifetime, will lead to a reduction in the enthusiasm to provide and encourage teachers to use technology in their classroom. In addition, head teachers who have not received any training courses on how to use technology and evaluate its impact on students, may will not support technology in schools. Both factors may affect the head teachers, which subsequently

			reflected negatively on the teachers' decision to use technology with their students.
2-What are the types of technology you use with those students?	I prefer to use IWB.	I prefer to use IWB.	I prefer to use IWB.
3-Does the technology help you cover the key mathematics concepts in the syllabus?	-	-	Yes
4-Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?	-	-	The first is to enhance the teaching quality through improving the interaction, communication and collaboration levels; moreover, encouraging learning by increasing motivation and readiness of students to solve mathematical problems.
5-Have you learnt anything new by using technology in your class?	No	No	No
6-What are the main reasons behind the decision of the mathematics teacher to not use technology to help students with mathematics	School.	School.	School.

difficulties? (Teachers themselves, school, government).			
7-What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of: - Training teachers to use technology? - Technical support? - Teacher attitudes and beliefs about teaching mathematics with technology?	Head teacher attitudes and beliefs about teaching mathematics with technology.	Head teacher attitudes and beliefs about teaching mathematics with technology.	Head teacher attitudes and beliefs about teaching mathematics with technology.
8- Do you need any further support to use technology, and if so, what support do you need?	More encouragement.	More encouragement.	More encouragement, and provide me with appropriate training and technical support.

Table 5.3: The responses of three teachers who did not use technology on the first part of the interview questions

1- Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology? (Then I will move to questions six, seven and eight).

Teacher four pointed out that they do not have any type of technology in the classrooms such as Interactive Whiteboard, projector data show and computers. He added:

I referred to these types of technologies as they are the most commonly used in the Kingdom of Saudi Arabia. Let me share something important. As we know that rewarding outstanding teachers in schools will motivate other teachers to work more and more to help students in their learning. On the contrary, if the teachers feel that there is no rewards system in their schools, this may they discourage them to make more effort. Now, since I have no idea how to use technology in class for mathematics lessons, and, thus, I have not tried to surmount this obstacle, because I need more encouragement in place in order to receive the required training and thereby demonstrate innovative teaching. As such, I did not decide to use technology, although I understand the positive impact of IWB on learning amongst students who have difficulties in mathematics. As a result, I might change my mind if there is support and encourage the use of technology.

Teacher five gave wise advice before answering the above question. He pointed out school leaders can have an impact on enhancing better instructor performance, and student outcomes if their leadership practices, reflective encouragement and motivation is supportive.

Hence, the teachers are directly influenced by the leadership quality of principal. This encompasses the manner they perform, do their planning and take decision upon their teaching approaches along with practices of learning. It also includes their individual competence, dedication and intellect of welfare, along with their faith and devotion for the school that puts an impact on results of learner indirectly. I will link my thoughts to your question: why do I not use technology? I believe that interactive whiteboard has a significant impact on students, especially those dealing with the difficulties of mathematics, and that some students here have concerns about learning mathematics and in order to help them effectively requires an entertainment mechanism through which students are encouraged to learn mathematics with confidence and fun. However, this school does not have the technology, and even if we assume that, hard work was devoted to acquire such technology, we are aware that the Ministry of Education has a sufficient number of devices, but I find yet another obstacle, that indicates a lack of effective training to use technology. Even if we assume that diligent work had been undertaken to provide us with training courses; there is a lack of technical *support to help us when needed. All these obstacles accumulate because we need more support from the Principal to remove these obstacles.*

Moving to teacher six, who offers an interesting answer. In his opinion, the school head acts as intermediaries who encourages, supports and helps teachers to use technology for teaching/instructions and process of learning, and hence incorporated technology within the system of education. The school principal's assistance is very important as the success related to technology incorporation into learning and teaching depends on it. Therefore, the principal can either be a critical factor facilitating or hindering teachers' use of computers for the purpose of education. He added:

I mentioned this information about the head teachers, because I met three head teachers at different schools during my work, I noticed that the head teacher's age is an important factor influencing technological integration in schools, because one of them was younger than the other head teachers, and he knows the importance of technology in teaching and learning, and was, therefore, willing and enthusiastic to provide and encourage the use of technology in our classrooms. We may conclude that the age factor will affect enthusiasm to provide such technology in schools as well as offer encouragement to use it. In addition, he holds a bachelor and diploma in computer science, and he received in-service training about the effect of technology on education and how to encourage teachers to use technology. Another head teacher, has a bachelor's degree in mathematics, and has not received training in either the use of technology or its impact on students. Because without a doubt, in-service training emerged as an important factor, which may improve the school heads' perception towards computers, thus facilitate their efforts of integrating computers into the learning institutions. All of these factors concerning the background and orientation of head teachers may reflect negatively on teachers' decision to use technology with their students. However, I still believe that technology has a positive effect on students, particularly those with difficulties in mathematics.

It is clear from the above answers, that the school's principal plays a key role in the provision of technology and also on the decision to use it with students. Despite that, all respondents believe that technology has a positive impact on students who have difficulties in mathematics. Teacher four reported the reason for not using technology was that he needs more encouragement to receive the required training and thereby demonstrate innovative teaching. While teacher five said that a lack of head teacher encouragement to provide support in removing the obstacles faced providing technology, appropriate training and technical support, was critical. Teacher six offered an interesting answer based on his experience. He found that there are relationships between age factor, in-service training of the head teachers and the principal's facilitating efforts towards integrating technology in schools and encouraging their staff to use it. Whatever progress a headmaster makes in a lifetime, will lead to a reduction in the enthusiasm to provide and encourage teachers to use technology in their classroom. In addition, head teachers who have not received any training courses on how to use technology and evaluate its impact on students, may will not support technology in schools. Both factors may affect the head teachers, which subsequently reflected negatively on the teachers' decision to use technology with their students.

Before continuing to provide answers to interview questions, it is interesting to go back to the beginning of this chapter, particularly the educational background and work experience for each teacher. The first appointment of teacher four was at this school, and, as we know, there is no technology in this school. Turning the page to teacher five, I found that upon his graduation, he started his career as an instructor at one of the primary schools. He spent two years at that school where he taught mathematics to KS (Key Stage) four and five learners, and he then decided to move to this school. Moving on to educational background and work experience for teacher six, where he has served in three schools after his University graduation, thus five years in three primary schools instructing Year four and Year six students. He was fortunate when he began teaching at school one because there was technology available, and, as he said to me, this is due to the positive attitude of the head teacher seeing at least part of his role being to provide technology and encourage teachers to use it. While teaching in schools two and three, the latter being this school, there was no technology usage in both schools.

I can see much from the educational background and work experience for teachers four, five and six. Teacher four's first appointment was in this school. This means he did not have any experience working with technology. This is the second school appointment for teacher five, but both schools do not have technology. Teacher six taught at two schools before this school, which is the first school he taught in that has technology and this is due to the positive attitude of the head teacher towards providing technology and encouraging teachers to use it. In contrast to the second and third schools, who do not have access to technology because of the attitude of the director and its impact on the decisions of teachers. This is also the same reason behind the responses of the fourth and fifth teacher. Therefore, I asked teacher six the same questions in part that I asked the three teachers at school A who have used technology in their classroom, and benefitted from the experience. However, I did not forget to ask teachers four and five some appropriate questions to help me obtain informative answers to the research questions. Let us move on to the next question of my interview.

2- What are the types of technology you use with those students?

It is interesting to mention that all the three teachers prefer to use interactive whiteboard, if there is an opportunity to bring the technology to this school, as they have had heard a great deal about the benefits of this tool in mathematics education from their colleagues at other schools. Teacher six pointed out that he preferred this tool because the electronic IWB (interactive white board) is a device, which combined a wide range of functions that could be adapted in all mathematics lessons at all primary school levels.

3- Does the technology help you cover the key mathematics concepts in the syllabus?

Teacher six reported that the technology could help him review key mathematics concepts in the syllabus. However, he wished to be clear, therefore, he added:

> *Before the ME (Ministry of Education) developed the mathematics curriculum, I found it difficult covering all mathematics topics within the syllabus with computers, there were some topic structures in the past mathematics curriculum, that were not helpful to me with regard to finding a suitable means of presenting the lesson through technology. However, following the curriculum development, I can easily use technology on learners with difficulties because the lesson has been structured in a manner that allows the use of technology. In this school, I have had difficulty in dealing with the curriculum without the technology which the curriculum requires, especially after its development.*

4- Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?

The table above demonstrates that teacher six thinks that IWB can help students with mathematics difficulties learn. This will happen in two ways:

> *The first is to enhance the teaching quality through improving the interaction, communication and collaboration levels; moreover, encouraging learning by increasing motivation and readiness of students to solve mathematical problems.*

5- Have you learnt anything new by using technology in your class?

Teacher six reported that in 2010 he learnt how to use Interactive whiteboard with students with mathematics difficulties. He selected the electronic IWB (interactive white board) because it is a device that combines variety of functions, and can be used in every primary schools' levels for teaching mathematics lessons.

He added:

> *The head teacher in the school I was affiliated with in 2010 tried to encourage us to attend the necessary training to learn the effective use of technology with students. In addition, in certain instances, the director also attended the training sessions, sending us a valuable message as role models, saying in effect, that: I encourage that you and I attend these sessions to enhance knowledge and that this technology will facilitate my work in administration as well as yours in the classroom.*

It is important to be clear about question six, wherein these three teachers who do not use technology in school B, tried to answer question one, which found that the main reason behind the decision of the mathematics teachers not to use technology to help students with mathematics difficulties is the head teacher. Therefore, I will move on to the next question, which is number seven.

7- What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of (Training teachers to use technology? Technical support? Teacher attitudes and beliefs about teaching mathematics with technology?

Teacher four pointed out his experience with the major obstacles facing teachers when using technology with those students who have mathematics difficulties in this school.

As you know that I do not use technology in this school at all, but I can answer your question from my experience in this school. I found that the attitudes of the head teacher are directly related to the availability of technology and the use of it in the classroom. To be clear about the shaping of attitudes, this included the age of the director and their knowledge about computers. With regard to knowledge about computers, if the head teachers have good knowledge about the impact of technology on learning, they will help teachers by the provision of technology and supporting them during its use. I know that the Ministry of Education, supported by our government, will help the teachers by providing technology to the schools, but we want the directors to be more active in motivation and encouragement when using technology.

Teacher five pointed out an important answer regarding head teachers' and teachers' perceptions of technology.

Investigating principals and instructors' perception towards technology within the education system is a valuable gesture. This is because developing constructive perceptions about the school as well as learning is a critical precursor towards academic success. Conversely, negative perceptions hamper the achievement of academic success. In my opinion, positive attitudes toward technology are important prerequisites to helping teachers successfully integrate and use technology in the classroom. I presented such a speech to school principals based on my experience. To summarize, the major obstacle facing teachers when using technology with students is the attitudes of head teachers towards technology, which leads to a lack of attention with respect to the provision of technology and the facilitation of the presence of technical support in schools. This results in the discouragement of teachers to attend training courses. Eventually, we will find many other obstacles which must be overcome.

Teacher six tried to revisit the first question to add an important point, and link his remarks to the answer of this question.

I want to add or to clarify my answer to the first question, which will enable me to better answer it. As I mentioned before, the age and in-service training of the principals are critical factors that may affect technology integration and use at schools. I would add herein that teachers' or a head teacher's field of study is *correlated to their attitudes toward technology. As you know I have experiences with three head teachers, with the first one holding a bachelor's and diploma in computer science. He currently works with the Ministry of Education to provide IWB for all classrooms. However, the second head teacher held a bachelor's degree in mathematics, and did not support the provision of IWB in their school.*

Therefore, he concluded that head teachers who graduated from computer subjects appear to have positive perceptions and attitudes towards technology and its integration into teaching and learning. He added that, in his opinion, the major and most important obstacles that faced teachers are the attitude of head teachers toward technology in term of provision, integration and use in the classroom. If this obstacle is overcome, then it will be easy for us to address other obstacles faced when using technology, such as the lack of training and technical support.

It is clear from the answers of the three teachers, that the major obstacle when they are using technology with those students who have mathematics difficulties is the attitude of head teachers towards technology with regard to providing, integrating and using technology within the classroom. The demographic variables included the age and knowledge about computers as cited by teacher four. Teacher five emphasised that the main obstacle facing teachers when using technology is the attitudes of head teachers towards technology. In this regard, teacher six explained that what he meant by attitude is the age, in-service training and field of study of the principals. All these factors influenced these teachers when they considered the use of technology.

Moving to the responses of the three teachers who did not use technology, on the second part of the interview questions (see table 5.4).

Questions	Teacher four	Teacher five	Teacher six
1-Why did you decide to use/not use technology for this lesson with students who have mathematics difficulties?	-	-	-

2-Is technology used to increase basic skills, to make the understanding of complex mathematical operations easier or as a resource to entertain students?	-	-	I think for both, to provide a better understanding of complex mathematical operations and as a resource to entertain students.
3-How often do you use technology when teaching students with mathematics difficulties?	-	-	-
4-Where do you usually get your ideas from for using technology? (Magazines, colleagues, workshops, technology coordinator, Internet, by yourself, etc.)	-	-	By himself and some of his colleagues.
5-Did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe? If not, how did you overcome the problem of training?	Yes, I studied one subject during my college education.	Yes, I studied one subject during my college education.	Yes, I studied one subject during my college education.
6-If offered, how likely would you be to	With pleasure.	With pleasure.	With pleasure.

participate in technology training either during or after school time?			
7-If no, what factors may have led you to not attend training sessions?	-	-	-
8-What is needed to make the necessary teacher training work?	-	-	-
9-If you wanted a technical support in your class but it is not available in the school right now, how would you overcome this problem?	-	-	-
10-How can we overcome the negative attitude of teachers towards the use of technology?	All three teachers tried to discuss the importance of the use of technology in mathematics, particularly with students who have difficulties with mathematics. Therefore, they think that if the teachers discuss their need of technology and show the advantages of using it, this may help them to change head teachers' attitudes.		

Table 5.4: The responses of the three teachers who did not use technology on the second part of the interview questions

2- Is technology used to increase basic skills, to make the understanding of complex mathematical operations easier or as a resource to entertain students?

Teacher six answered the above question from his experience at first school. He reported:

> *I think both, in order to provide a better understanding of complex mathematical operations and as a resource to entertain students. I knew that you would ask me 'how', therefore, I will explain it to you. Current students live in a world of technology outside the confines of the school, using many different types of technology now available in markets, and they use it to entertain themselves. Some parents are intelligent, in that they try to add some applications in their*

children devices to support their children's at home 'explorations', wanting their children to use technology as a learning resource. As a result, before I came to this school, I used IWB every in single lesson with programs that entertain students in the classroom, but also achieving the objectives of the lesson and making complex mathematical operations easier to understand. Some parents also wanted to take advantage of this entertainment technology and involvement with the objectives of the lesson, in order to become more effective in helping students understand and love mathematics.

4- Where do you usually get your ideas from for using technology? (Magazines, colleagues, workshops, technology coordinator, Internet, by yourself, etc.)

Teacher six usually got the ideas for using technology from himself and the internet when he was at his previous school, He added:

I commonly capitalize on the software and programs offered by the IWB and incorporate my ideas to assist learners with mathematics difficulties. Notably, all programs provided by IWB would be irrelevant if the instructor does not put his/her ideas to proper and constructive activities. Moreover, in some instances, I visit certain internet sites to acquire knowledge on the experiences of mathematics instructors.

5- Did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe? If not, how did you overcome the problem of training?

It is interesting to mention that all three teachers who do not use technology in school B, studied one subject during their college education. This subject provided them with the necessary skills alongside knowledge of operating their computers and performing tasks. This enabled them to be acquainted with computers as well as Microsoft Windows, while acquiring basic keyboard, mouse and computer skills within a supportive setting. Teacher four pointed out:

I benefited from this subject during my college years in various ways, for instance, switching on and switching off the computer, undertaking key tasks using Excel, PowerPoint and word processor, organising print settings alongside documents, *utilizing a web browser for internet access coupled with posting and retrieving electronic mail.*

While teacher five spoke morosely because he did not practice what learnt at his University in his classroom.

I learnt from this subject the essential computer skills only, including Word-processing, using a Spreadsheet, using Power Point, printing the document, using the Internet and how to open, send, receive and close email.

Teacher six pointed out that basic computer skills are a must in today's school. I asked him what he learnt about such skills at University, he answered:

I know I learned some basic principles for the use of the computer, but I remember that the lecturer did not cover a lot of topics, such as how to use Internet effectively.

I can see from the answers that have been provided by these three teachers, that all of them learnt the basic skills on using computer. These are evidenced when teacher four and five, learnt various skills such as performing basic functions with the word processor, Spreadsheet, Power Point and Excel, printing documents, using a web browser for Internet access alongside the use of email. While teacher six learnt some of these basic skills only, leading those students to not take full advantages of the subject.

Before I finished the interview of these three teachers, they added an interesting point. Teacher four pointed out that:

As you observed during my teaching in the classroom with those students who are suffering day after day from the mathematics, because my teaching methods are not in line with the new mathematics curriculum, which was developed by the Ministry of Education, these are important issues. We see that presenting the curriculum for students needs to be augmented by technology to facilitate students' learning of mathematics, before aggravating the problem and then leading to a situation that cannot be controlled.

In addition, teacher five and six seemed upset because they do not use technology with their students. They both agreed that the students have access to technology to entertain themselves outside the classroom, and they know that mathematics is difficult subject for students. To make mathematics easier and address their misconceptions, we must, as educators, seize opportunity from their love of technology and merge it with the subject of mathematics, which will lead to future student perceptions that mathematics is not difficult. Teacher five added:

> *I hope to hear soon that technology will be used in this school, because the benefits of it are clear to us as teachers. This was apparent when a competition in mathematics took place between some of the students of this school and some of the students from another school. When we found, at the end of competition, that the students in other school outperformed our students by degrees, we were disappointed.*

I asked teacher six about this competition and his opinion on the results of the students and the reasons for the low grades of their students. He reported out that:

> *Yes, there was a competition between our school students and students from other schools in mathematics. The competition was dependent on agility and intelligence. I was surprised at the results of the competition which found that their students surpassed our students to a significant degree. When I met with their mathematics teacher, I asked him about their secret and he told me proudly, 'I use smart interactive whiteboard with my students which made them come to love mathematics and do exceedingly well in competitions'.*

After that it came to my mind to ask each teacher the following question to try helping the stakeholders find suitable solutions for those teachers.

10- How can teachers overcome the negative perceptions of principals towards the provision and encouragement to use technology?

All three teachers tried to discuss the importance of the use of technology in mathematics, particularly with students who have difficulties with mathematics. Therefore, they think that if the teachers discuss their need of technology and show the advantages of using it, this may help them to change head teachers' attitudes.

5.3.1 Summary of the Interviews Answers

I interviewed six teachers	
Three mathematics teachers from school A which used technology	Three mathematics from school B which did not use technology
Key points emerging from the answers of teachers in school A:	Key points emerging from the answers of teachers in school B:
- The type of technology and the reason for its use. All three mathematics teachers have used Interactive Whiteboard in their classroom to help students with mathematics difficulties, and each have different reasons for using technology.	- The type of technology and the reason of use. The school has no technology, and all mathematics teachers in this school unanimously believe in the usefulness of technology for the students who find mathematics to be difficult. In this context, each has a different reasons for for non-use technology.
- Teachers' experiences with technology. All of them have experience in the same type of technology that is Interactive Whiteboard. Teachers modify it according to the necessity of their students. It should be mentioned that IWB provides teachers with the freedom of introducing various teaching methods in the classroom.	- Teachers' experiences with the technology. Teacher six reported that the students find it very interesting when difficult mathematic calculations are represented through technology and it even helps to enhance their fundamental knowledge regarding the subject. During his employment at his first school, the sixth teacher usually preferred to get the ideas for using technology, from his own resources and the internet.
-Technology and the all key mathematical concepts. They agreed that technology helped them cover the all key mathematical concepts in the syllabus, after the development of the new mathematics curriculum.	-Technology and the all key mathematical concepts. The sixth teacher reported that the technology can help him cover the key mathematics concepts in the syllabus. However, this happened after the development of the new mathematics curriculum, but before development of the mathematics curriculum, he cannot cover the key mathematics concepts, because he does not find an appropriate way to present the lessons.
-Technology and students' help. They agreed that technology can help students to overcome the difficulties of learning mathematics. When teachers were asked how learners can benefit by technology, all the answers were	-Technology and students' help. The sixth teacher thinks that IWB can help students with mathematics difficulties to learn in two ways: 1). to improve the quality of teaching and learning processes by enhancing levels of

different.	interaction, communication and collaboration. 2), to boost the motivation and aptitude of students who experience difficulties in working mathematical problems. In 2010, the sixth teacher has learned how to use Interactive Whiteboard with students who have mathematics difficulties. The reason for his selection is the device electronic whiteboard is able to combine many more usages as adapting them in the lessons of mathematics and primary school levels can be very beneficial.
-Attend a training. All of them attended a course, and the aim of attending this training session was to avail all to the advantages of smart board, particularly, for the benefit of the students who struggle in understanding mathematics. Moreover, each teacher has a different motive for being trained in using technology. All the teachers were very eager to attend those training sessions on using technology and they were ready to attend the specific programme provided to them.	- Technology favourites. It is interesting to mention that all the three teachers prefer to use Interactive Whiteboard. If there is an opportunity to bring the technology in this school they want Interactive Whiteboard, because they had heard a great deal about the benefits of this tool in mathematics education and from their friends at other schools. The sixth teacher pointed out that he prefers this tool because the electronic Interactive Whiteboard is a device that combines a variety of uses which can be adapted for use with all lessons in mathematics and all levels at primary school.
-The main reasons behind the decision for not using technology. As I can find that the first and third teachers have agreed that the main reasons behind the decision of the teachers in mathematics for not using technology to help students with mathematics difficulties in school only. On the contrary, the second blamed the teachers and the school as well.	- The main obstacle facing teachers while using technology The major obstacle they faced was the attitude of the head teacher. All three teachers tried to discuss the importance of the use of technology in mathematics, particularly with students who have difficulties with mathematics. Therefore, they think that if the teachers discuss their need of technology and show the advantages of using it, this may help them to change head teachers' attitudes.
- The main obstacle facing teachers while using technology. The attitude of the teachers and the beliefs about teaching mathematics with technology, teacher training and	The college' education. It is interesting to mention that all three teachers who do not use technology in school B, studied one subject during their college education (I mean by a subject

technical support. By considering these issues, we can increase the effectiveness using technology in education within the classroom.	that includes any learning activities on how to use technology for teaching those students, and this subject provided them with the necessary skills alongside knowledge of operating their computers and performing tasks. This enabled them to be acquainted with computers as well as Microsoft Windows, while acquiring basic keyboard, mouse and computer skills within a supportive setting).
-Further support. All three teachers felt no need of any further support to use technology because the principal of their school is encouraging them in using IWBs.	-The new mathematics curriculum The fourth teacher pointed out that the new mathematics curriculum and his way of teaching does not synchronize with each other. Likewise, the fifth and sixth teachers seem upset because they do not use technology with their students. They both agreed that students live outside the school using technology to entertain themselves, and they know that mathematics is difficult for students. To make mathematics easier and remove the misconception from their minds, we must, as educators take opportunity from their love of technology and merge it with the subject of mathematics to make it interesting for them, which results in a future student assessment that mathematics is not difficult.
- The effect of IWB on mathematics difficulties. Each teacher mentioned the different effect of IWB on difficulties with mathematics	I would like to explain to the reader how I dealt with the other teachers in school B who do not use technology in their school. As we know, this is the first professional encounter for the fourth teacher in this school, thus, he has no previous experience of using technology. As for the fifth teacher in spite of this school being his second, neither of the schools use technology. The sixth teacher taught in two schools before joining this school. The first one had technology and as he relays, the positive attitude of the head teacher as the one who made it possible, as he always motivated us to use technology. On the contrary, due to the attitude of director and its impact on the decisions of teachers to use technology, he could not use the technology in his second and third
-The reasons of using technology Teachers are agreed that the use of technology to increase basic skills, make the understanding of complex mathematical operations easier and as a resource to entertain students is beneficial. They have used technology every day with their students. However, each one reported the way that the use of technology helped him in every class, and want new mathematics teachers to	

benefit from their advices.	school. The fourth and fifth teacher experienced the same thing. Therefore, I asked the sixth the same questions in part A that I had asked the three teachers at the school A who use technology in their classroom, in order to benefit from his experience using technology. Apart from that, I interviewed the fourth and fifth teachers with some relevant questions to supplement my research work. Let us move to the key points emerging from the answers of teachers who do not use technology in school B.
-Where do they usually get their ideas from for using technology? They rely on themselves to get suitable ideas for using technology with their students. However, the second teacher sometimes searches through the websites. The third teacher also has had constructive discussion with his colleagues over the experience of using technology.	
- College education. The college education of the first and second teachers included learning activities on how to use technology for teaching students. However, in this regard, teacher three's college education not included any learning activities on how to use technology for teaching those students, but this issue was overcome by attending supportive training sessions on using technology.	
-What was needed to make the necessary teacher training to work? They made their focus on their school principal, and they shared details about the significant role of the school director to make the training session successful for teachers.	
-The negative attitudes towards the use of technology. With the second and third teachers their answers centred on one point: that when we help the teacher with negative attitudes towards the use of technology, we should provide him with appropriate training with focus on practice. The first teacher who slightly differs with their answer, suggests that he will ask the teachers who have a negative attitude to attend a lesson with a teacher who uses technology, in order to see the positive impact of technology on students for himself.	

5.5: Summary of the Interviews Answers

5.4 The researcher's observations

As I mentioned in the previous chapter that the second data collection method was direct observation, with the same six mathematics teachers interviewed. Three in school A that used technology with their students, and the other three in school B without technology. I observed each teacher taking hand written notes for 45 days separately, over a period of three months. The three teachers in school A were observed during the first 45 days, and the other three were observed for another 45 days, each class period being 45 minutes. At the beginning of each six class period, the teacher communicated my goals to the students.

The main goal of the use of this approach is to extend and support the data obtained from interviewing teachers. Therefore, I tried to answer the following questions during my observations in the three classrooms that used technology in school A with those students who have difficulties in mathematics.

- The lessons where the mathematics teacher tried to use technology?
- The type of technology that was used to assist those students?
- The ways in which mathematics instructors utilize technology inside their classrooms?
- What were the results from the use of technology on learners with mathematics problems?
- Were there any challenges in using the technological instruments?

The other three classrooms that did not use technology in school B, with students who have difficulties in mathematics, were also guided by the following questions:

- How does lack of technology use within the classroom impact:
  Use of time in class? How learners acquire knowledge? Teacher attainment of objectives for the lesson? The interaction of learners in this lesson?
- Does the lack of technology have a negative or positive impact on the learners during the mathematics lessons?
- What are the impacts of the lack of technology on the current teaching method?

In this session, I will analyse each teacher separately, which presents each three teachers in a summary table and then each one in a detailed separately, starting with those three teachers who used technology (see table 5.6), and then the three teachers that did not use technology (see table 5.7).

The following are the researcher's observations on the three mathematics teachers in school A with technology.

Session	Teacher one	Teacher two	Teacher three
Date: Number of the lessons: Each class period: Class level: Number of students: Mathematics lesson on:	o 25/09/2014 - 10/11/2014. o 30 lessons. o 45 minutes. o Year six. o 20. o Multiplication.	o 25/09/2014 - 10/11/2014. o 30 lessons. o 45 minutes. o Year four. o 20. o Subtraction.	o 25/09/2014 - 10/11/2014. o 30 lessons. o 45 minutes. o Year five. o 25. o Multiplication.
The description of classroom generally.	o He spent some lessons with his students in the laboratory. o There were four walls coloured in green. o There was an interactive whiteboard (IWB). o The students' seats were arranged in a semi-circle. o Each student had a computer, with the number of computers totaling at 20. o There was no special table or chair for the teacher.	o The classroom was spacious. o There was an IWB, a projector, and a computer. o There were posters on the walls to motivate students. o The seating arrangements were in groups of five. o There was enough electrical outlet.	o A 42-inch TV was fixed to the outside wall of this school. o The teacher had drawn a large image of sunshine with a funny face on a white cork board. o There was an IWB, a projector and a computer inside the classroom. o A large panel hung on the inside wall to show the work and achievements of the students. o The seating arrangement was in a semi-circular pattern. o There were four windows with curtains. o There was one plant in the right

			corner of the classroom.
Description of the classroom environment.	o The teacher was friendly. o He encouraged students to interact and effectively participate in the classroom. o He always smiled when talking to the students. o He interacted with his students using physical gestures. o He was open-hearted with and receptive to his students.	o The teacher had a good sense of humour. o All his students respected him. o He gave all the students the same amount of respect and tenderness. o If he noticed during the lesson that some students were not interested in the lesson, he immediately stopped and tried to change the subject, and then got back to the lesson. o His facial expressions and the way in which he spoke to the students showed that he was very pleased to teach them.	o The teacher had a positive relationship with his students. o He was friendly. o He had equal respect for students from various cultures and backgrounds. o He never discouraged his students from achieving something that was not related to mathematics or technology. o He helped the students become aware of how mathematics was applied to real-life problems. o The students felt comfortable and safe with him.
The lessons for which this teacher tried to use technology.	o He used IWB in every single lesson, and he used the Mighty Mathematics Number Heroes program through the IWB to help students overcome the difficulties they have in mathematics.	o He used IWB for every lesson, as well as a video camera with which he added some sound effects to the videos used. He used the huge potential offered by IWB to help his students overcome difficulties in mathematics.	o For every single lesson, he used the Number Race program and PowerPoint presentations through the IWB to help the students with their difficulties in mathematics.
The areas of difficulty that the students had in mathematics.	o Some students failed to understand that any number multiplied by zero equals zero.	o Some students did not understand how to borrow from zero in subtraction calculations.	o Some students failed to understand that any number multiplied by zero equals zero.

	o The students found it difficult to understand that multiplication does not always make results bigger.		o Two students found it difficult to deal with subtraction tasks such as 20 minus 13, for which they took a long time to answer, and answered it wrong.
The effects of IWB on students in teaching and learning mathematics.	o With regard to teaching, this appeared when the teacher used the save feature of the lesson to be opened at any time, later. o With reference to learning mathematics, generally, the use of IWB was able to shift the negative attitudes of students to a more motivated and active attitude. o In facility mathematics difficulties, it was able to build mathematics confidence in a fun and interactive way.	o With regard to teaching, the IWB was able to save the teacher's time in the classroom. o In learning mathematics, generally, this tool enabled the reduction of negative results that arise from these difficulties. o In facility mathematics difficulties, showed the speed of response of students to overcome the difficulty.	o It helped identify the students' strengths and weaknesses. o It helped improve and boost their working memories. o It enhanced their confidence and the students did not hesitate while answering the questions.
The challenges faced by the teachers during their use of IWB	It is interesting to mention that all these three teachers did not find any challenges during their use of this tool, and this could also be because of the positive effect that the school's head teacher had on them.		

Table 5.6: My observations of teachers who used technology

5.4.1 Teacher one

School: A with technology.
Date: 25/09/2014 - 10/11/2014

Number of the lessons: 30 lessons.
Each class period: 45 minutes.
Class level: Year six
Number of students: 20
Mathematics lesson on multiplication.

5.4.1.1 The description of the laboratory and my observations

First of all, this teacher spends some lessons with his students in the laboratory. Therefore, I would like to give the reader the feeling of this laboratory, in terms of what it looks like, how its furnishings and contents are arranged, bulletin boards, and its physical atmosphere. This undoubtedly has a direct impact, not only on the learners, but also on the teacher.
When you enter the laboratory, you will find that the four walls are coloured in green. After my first observation of this teacher, I asked him why these walls are painted in green colour, because I noticed that all the other classroom walls in the school were white in colour, except this laboratory. His answer was as follows:

> *I believe that students who have difficulties in mathematics need this colour to alleviate stress and anxiety from mathematics and to relax. Eventually, I will be able to help them eliminate all the difficulties they face, easily.*

After entering the lab, you will find on the right side an interactive whiteboard, and on the left side students' seats, which I noticed were arranged in a semi-circle. Every student has a computer totalling 20, and they could not use it without prior permission from the teacher. At the beginning of the lesson, the teacher asked all students to look at the Interactive Whiteboard and explained the daily lesson and then after 20 minutes, the teacher allowed them to use the computer to practice what they learned during the lesson. It is worth mentioning that this lab does not have a special table and chair for the teacher, because this teacher believes that the role of the effective teacher is to stand in front of students with constant interaction, and meet all the needs of individual students by walking around, watching, and evaluating student progress. He said this would not be possible if the teacher sat on the chair without any interaction or observation of the students.

Moving to the classroom environment, the teacher created a friendly environment inside classroom, and this was evident seeing the students' cooperation with each other. For instance, when the teacher finished explaining the whole lesson, usually 10 minutes before the end of class, he asked all students if they had any questions about the lesson. One or two of those students raised their hands, which meant they had questions. I noticed that in each class, the teacher asked one or two students from the rest of the learners that did not raise their hand, to go and help them answer their questions. I noticed that all students were competing to get a chance to help their friends; this appeared when I saw all the students' hands raised wanting to participate in helping. I do not want to forget that while the students got help from their friends, the teacher constantly walked around the learners to make sure that a student who raised a hand got the correct answer. This means that the assistance that the student received was also under the supervision of the teacher. All this came about because of this teacher, who wanted to make the class environment friendly, increase students' confidence, develop leadership, and ensure that all of them understood the lesson well.

With regard to encouraging students to interact and effectively participate in classroom, I noticed that the teacher divided the students to two groups; the first ten in group A and the other ten in group B, where the total strength of students in this class was twenty. Usually in the middle of the class, the teacher asked questions in an interesting way using an interactive Whiteboard. The first group which responds to a question immediately will get three points and so on. Indeed, I noticed three benefits to the students when their teacher used this method. The first is that the students were keen to participate in front of their friends to get positive feedback from the teacher, whether the answer was right or wrong. That led to the continuity of student participation in the classroom without feeling bored; boredom is a result of lack of concentration during a lesson. The second is that the group which collected more points won. The teacher then put their names and photographs on the board outside the classroom. This generated an enthusiastic discussion among all students in the school about these students and every student wished that their names and photographs be on this board in the future, leading them to strive more and more to get on this board. For more information please see page 119.

5.4.1.2 Information about the students in this laboratory

According to my observations and the teacher evaluation sheets, I found various types of difficulties that some students have in this classroom. These difficulties included failing to understand that any number multiplied by zero equals zero. However, I noticed another difficulty that this teacher did not mention during the interviews that some students thought of multiplication as always resulting in bigger numbers such as 0, 5× 3= 3. In addition, some of them also when multiplying three by zero in the previous task answered 3, because they cannot imagine that multiplication does not always result in a bigger number.

During my observation, I also noticed the reasons for this teacher's intensive focus on the multiplication. Because he believed that the students' understanding of multiplication effectively will facilitate learning equivalence, fractions, division facts, and long division. He used IWB with all lessons, but he creatively used an interactive whiteboard with this lesson in particular.

I could see from the teacher evaluation sheets for students that there were two kinds of students in this laboratory. Some students of the 20 have anxiety and depression from learning mathematics. Some others students show enthusiasm, optimism, and curiosity when learning. During my observation, I did not notice any behavioral problems among all students.

5.4.1.3 The lessons for which this teacher tried to use technology and how

I noticed that this teacher used one type of technology, which was IWB for each single lesson with those students who have mathematical difficulties. This means that for the period of my observation, he used this tool with lessons such as mathematical equivalence, fractions, multiplication, and division. Backing up a little to the previous comments, I can find in his answers to the interview questions, the reason for his using of this tool particularly. However, this method helped me more and more to investigate how he used this technology to help his students with multiplication difficulties.

As mentioned before, some students have specific difficulties in mathematics, which centred on the lack of full understanding of multiplication concepts, which has already affected their understanding of the rest of the mathematics concepts such as equivalence, place value, fractions, and division. Therefore, in the first four weeks of observation of this teacher, I found that the teacher used a specific program to facilitate the difficulty they faced on the concept of multiplication. In the fifth week onwards, I noticed this teacher started to move to another concept in mathematics. However, he took the first five minutes of each lesson to recollect the previous program with those students, reminding them the concept of multiplication. Therefore, I am interested here to show you how he used the program, particularly with this concept.

Indeed, I noticed that the teacher used Mighty Mathematics Number Heroes program through the IWB. This means the teacher benefited from IWB during his use of the program. For instance, using the board with his finger as a mouse to control the program on his computer, highlighted the corresponding material on the mathematics task with 'electronic ink,' and saved any annotations or writings he made.

In regard to my observation of the use of this program and its effect on 20 students during 45 days, as one of my goals, I found this program, which is about playing with the basic building blocks of mathematics, suitable for students aged 8 to 11. This program took those students to visit mathematics metropolis where friendly number heroes rule the day. Through a picnic in this program, students faced a set of mathematics activities that encourage experimentation and investigation. One of these activities was turning the difficulty of understanding the concept of multiplication into learning through fun and to make learning enjoyable. This teacher was keen to use part of this program to help his students with learning multiplication and understand it clearly.

During my observation of the teacher in the first month, I noticed that usually at the beginning of the class, he started to explain the concept of multiplication to all students by using this program. After 20 minutes into the class, he asked three to four students from both groups to come to the Interactive Whiteboard and practice what they learned; this activity was repeated. During this time, the teacher also asked the rest of students in both groups to follow their friends on the board and encouraged them to win. At the end of the last ten minutes, the teacher allowed each student to use this program in their computer, under his supervision. It is also important to mention that during my observation of the first month of this teacher, he tried to gradient and move slowly to other topics in mathematics such as division and fractions, but the main focus was to help his students overcome the difficulty in understanding multiplication.

In the last two weeks, I noticed that the teacher tried to fully move on to other topics in mathematics; the main focus of these two weeks were on other topics in mathematics such as division, and this happened after he made sure that the difficulty these students faced disappeared completely. However, during the first five minutes of each class, he switched this program on to double check that those students did not have any difficulty with it.

5.4.1.4 The effects of technology on students with difficulties in multiplication

The purpose of this point was to identify if IWB had positively influenced teaching and learning, which is divided into two parts: general learning and particularly, learning of the concept of multiplication.

In regard to teaching, I noticed that this tool had positive effects on the way the teacher taught the students. These results appear in many parts, but the most important one was when the teacher used the save feature of the lesson to be opened later at any time. This supported the teacher in the delivery of new information and linked it to the previous information easily, keeping his students familiar with all the concepts taught during his building blocks classes of basic mathematics, recalled by only a push of a button. This also saved the teacher time.

Generally, as I mentioned early, according to the teacher evaluation sheets for students, some students of the 20 had anxiety and depression because of learning mathematics. During my observation, I noticed that the teacher was able to shift these to a more motivated and active mindset through the use of the interactive whiteboard.

Particularly, we know that most of those students have difficulties in learning the concept of multiplication. In relation to that difficulty, I noticed that this program was able to build mathematics confidence, which gives students a strong foundation to build on, in a fun and interactive way while challenging all students. In addition, at the end of the last week, I noticed that all the students easily remembered the concepts of multiplication when they solved the task on hand, which indicated that they had overcome the difficulties they faced.

It is interesting to mention that I noticed this teacher not using this tool randomly; he was keen to choose programs that helped students participate more in Laboratory, persist through difficulties, and succeed in overcoming difficulties. In these programs, he did not give tasks to the students that led to the promotion of anxiety.

5.4.1.5 The challenges faced during the use of technology

I noticed the reflection of the positive impact of their head master's support on this teacher, in terms of providing appropriate devices and programs, technical support, and teacher training.

With regard to implementing the program, I could see that any support this teacher needed, he asked the head teacher unhesitatingly to provide, and then would get it the next school day. Moving to the provision of technical support, I noticed that in the fourth week, the lamp of the projector burned out in the first ten minutes of the class. Indeed, there were two things that impressed me: the first is how this teacher dealt with the situation confidently. I saw this before my own eyes, when his students did not feel any unease; this teacher gave them some tasks to solve while the technician fixed this issue. The second observation was the speed of the technical response to the teacher's request. When the lamp burned out, the teacher immediately informed the person who has experience in this matter, and we waited a a very short time before he came to the laboratory, encouraging this teacher to use the technology constantly.

To sum up, some of the students in this classroom have difficulties in multiplication concepts, which included failing to understand that any number multiplied by zero equals zero and understanding that multiplication does not always make bigger numbers. Their teacher used Mighty Mathematics Number Heroes program through the IWB, which benefited from the great features offered by this tool to help students. As a result, I noticed the positive effect of this tool on teaching and learning. This helped the teacher save the lesson through IWB, and open it at any time during the lessons when he needed it to connect the previous information to the new one, saving the teacher precious time. In regard to the students' learning, I found its effects on learning positive; this was evident when I saw the ability of this tool in shifting anxiety and depression among students of mathematics to a more motivational and active state. And particularly on learning multiplication concepts, I found it useful in building students' confidence. Finally, this teacher did not face any great challenges during his usage of the IWB, and this is a reflection of the positive impact of their head teacher in providing the interactive whiteboard, technical support, and teacher training.

5.4.2 Teacher two

School: A with technology
Date: 25/09/2014 – 10/11/2014
Number of the lessons: 30 lessons.
Each class period: 45 minutes.
Class level: Year four
Number of students: 20
Mathematics lesson on subtraction

5.4.2.1 The description of the classroom and my observations

This classroom is spacious and has interactive whiteboard, projector and one computer. All the three tools are connected together which allowed the teacher to control the computer directly from the whiteboard. I just realized the reasons mentioned by this teacher about the use of interactive whiteboard during the interview. It appeared in two scenes, the first when I saw how this tool simplified the difficult task and presented it in the form of entertainment. This scene reflected positively on the students, and I can see it through my observations in this classroom. These included the positive progress of the students in grade's daily assessment and the students' reaction when the teacher enters the class to start the lesson; they showed signs on their faces to show enthusiasm and ready to start the lesson. The second is the development of mathematics curriculum by the Ministry of Education which helped this teacher for daily use of this tool.

Coming back to the description of this class, I can find posters on the walls on the right and the left of the students which the teacher had put with motivational pictures and words such as 'mathematics is easy', 'I am intelligent' and 'I can do it'. During my observation, I noticed that if the students face any difficulty while solving the task, the teacher would ask the students to see the wall and read the poster 'I can do it' or 'I am intelligent'. As a result, this gave those students the power to continue to solve the task and not feel bored of mathematics.

In regard to the seating arrangements, I noticed that the teacher put the students' desks grouped in five, that is, each five students in one group. In some lessons, the teacher asked all groups questions, explaining that the quickest answer he would get from any group would result in more points or stars. I saw the competition between the groups, especially when the question needed a long time to answer it. I heard some students in each group asking their friends "who knows the answer.....quickly before them" and "quickly .... quickly before them". Therefore, this method of arrangements helped the teacher to monitor the student work and increased competition between the groups. In addition, it helped the students to increase the positive relationships between them through cooperative learning, which lead to building their knowledge, skills and understanding. For more information on how this teacher dealt with his students during the lessons, please see page 122.

5.4.2.2 Information about the students in this classroom

With regard to the difficulties these students have with mathematics, I found that some of them in this classroom struggled with subtractions, which is divided into two parts. The first comprised some students who had difficulties when borrowing from zero in subtraction calculations, for example, when they have to subtract 352 from 500. The second is some others who avoid the first difficulty by starting from $5-3$ and then $0-5$ and $0-2$ when they subtract 352 from 500, and the difficulty became more complex for them because they wanted to avoid dealing with the zero at the beginning of the task, and they made a mistake when they start to solve the task on the left side instead of right side. In addition, I noticed that when some of those students reach to solve $0-5$ and $0-2$, they answered 5 and 2, and some others stopped solving with a big question mark in their face. It is important to mention that I knew both these types of difficulties according to an assessment paper held by the teacher and my observations.

Moving on to students' behaviour in the classroom, indeed I noticed that the students were very friendly between each other, they heard the teacher's instructions respectfully, and took care of their classroom property. Therefore, I did not notice any behavioral problems among students. This was because I noticed that their teacher tried to promote positive behaviour before problems arise. In addition, he kept all students busy and challenged through his use of IWB which would make any disruptive behavior less likely to happen.

5.4.2.3 The lessons for which this teacher tried to use technology and how

During my observation, I noticed that this teacher used IWB for every lesson with their students such as mathematical equivalence, fractions, multiplication and division. However, as some of his students struggled more with subtraction, I noticed that the teacher tried to use the IWB with more creativity and innovation in subtraction lesson than the other lessons.

In the first week, the teacher began with topics based on the contents in the mathematics book. The second chapter in the book is about addition and subtraction which consists of all subtraction tasks. Therefore, the teacher spent two and half weeks to complete this chapter. It is interesting to mention that after two and half weeks, there were five students who had difficulty in subtraction. The teacher moved on to the next chapter on the last two days in the third week with a focus on these five students by reviewing and simplifying the difficulty they face, in order to help them to adapt to new lessons. To give you an example of this, at the beginning of the fourth week, I noticed that two of these students said to the teacher that they did not understand the long division at all, because they still carried with them the remnant difficulty of subtraction. As we know the work with long division, students rely on previous skills in dealing with subtraction to find the solution to the task of division. At the end of the last week of my observation, I noticed that one of the five students still had the difficulty with subtraction, making the teacher perform a new plan with this student through IWB to help him more and more.

In regard to how this teacher used the IWB with his students during 45 days, it is important to go back a little of my saying above that this teacher tried to use the IWB with more creativity and innovation in subtraction lesson than the remaining lessons. Indeed, as I noticed that when the teacher used the IWB with subtraction lesson, he tried to use something interesting with more effort. For instance, two days before the lesson, the teacher asked six students who had begun to overcome the difficulty of understanding the concept of subtraction to represent and embody subtract 352 from 500 in which the teacher put on the body of each one of them a poster paper with the number written on it. The first student represented the first zero on the right, the second one represented the second zero, the third student for number five and so on. It is important to mention that the teacher put those students in the form of a real task so that under the student who represented the number zero on the right was the student who represented the number two, and then under the student with number second zero was the student with number five, and so on. Then the teacher asked one of the students who had difficulties in understanding subtraction to go to the first student who represented first zero and ask him can I subtract you on 2 and he answered no it does not work, please go to my neighbour and borrow from him and so on. Eventually, the student reached to the student who represented number five, and he answered yes you can borrow one and take it to the next door which is number zero and so on. The teacher added some sound effects on this video through IWB beneficiary of the huge potential offered by this tool. For instance, when the student moved from number zero to the next zero, I heard knock sound and fantastic word appeared from IWB which gave more interaction and excitement between those students.

5.4.2.4 The effects of technology on students with difficulties in subtraction

In this section I will divide the effect of IWB on three aspects; these include teaching, learning in general and learning the concept of subtraction in particular.

In regard to teaching, I noticed that this tool saved the teacher’s time in classroom. For example, as per my experiences in education sector, I noticed that some teachers at the beginning of 15–20 minutes tried to write the tasks on the board and then started to explain the lessons to their students in many ways, which left little time of the class. Therefore, I found that this tool helped to save the teacher’s time because he had already saved all the lesson advances on USB Flash Drives, making him only to put this flash drive on the computer and open it through IWB. This way gave this teacher the chance to help those students more by starting immediately to explain the lesson instead of wasting time on writing on the board.

Moving to the effect of IWB on learning, in general I noticed that from the teacher’s evaluation sheets for students and my observations that this tool enabled to overcome the challenges that arise from these difficulties. In regard to its effect on learning the concept of subtraction, I noticed that also IWB was able to reduce the number of students who had difficulty in mathematics, which showed the speed of response of students to overcome the difficulty by learning with engagement. This showed that the effectiveness of this tool to draw the students’ attention made them to like mathematics which led to their desire to overcome all the difficulties they face.

5.4.2.5 The challenges faced during the use of technology

I did not notice any challenges this teacher faced during my observations. This means that I can see through my eyes what this teacher had answered me for the eighth question during his interview that the school principal has a positive impact on teachers in this school, making them to continue with enthusiasm to use the technology with students.

To sum up, it is clear from all lessons that some students had difficulties in understanding subtraction concepts. Some students had difficulties when borrowing from zero, and some other had difficulty to understand that they have to start on the right while solving the task such as subtracting 352 from 500. However, the teacher had intense desire to help those students with difficulties in mathematics. These appeared when I looked at his classroom environment, it included the way the class is organized, the psychological environment, motivation, competition and his positive relationships with the students. All the examples that I mentioned in the description of the classroom section proved that the learning or classroom environment can be a part of enhanced learning. The next part was the use of IWB and its effects of teaching by saving the teacher's time, in learning mathematics generally by reducing the negative results that were caused by the difficulty and drawing the student's attention and in learning the concept of subtraction particularly by drawing the students' attention that led them to like mathematics which resulted to overcome the difficulties they faced. Finally, as I found interestingly this teacher did not face any challenges, and this was because of the positive role of the school principal with the teacher.

5.4.3 Teacher three

School: A with technology.
Date: 25/09/2014 – 10/11/2014
Number of the lessons: 30 lessons.
Each class period: 45 minutes.
Class level: Year five
Number of students: 25
Mathematics lesson on multiplication.

5.4.3.1 The description of the classroom and my observations

Before I entered this classroom, I found a 42-inch TV fixed on the inner courtyard of the school, and the teacher had drawn a large image of the sunshine with a funny face on a white cork board which was next to the TV, and he wrote inside the sun with beautiful handwriting 'Mathematics is Very Easy'. Indeed, when I saw a 42-inch TV, I got the first internal impression that this teacher had a great fondness for technology. In addition, he had a strong desire to benefit from all the positive potentials that were provided through technology and use it to serve the students who had difficulties in the concept of multiplication.

I noticed that every day this teacher put a picture and the name of the students who exceeded difficulty. One day I tried to stand away from the TV to observe the students' reaction, particularly who are going through this tool. I was stunned from what I saw and heard from some students such as I wish that instead of this student I will study to become better than him. Actually, I found that the teacher wanted to encourage students through TV to have positive competition to overcome the mathematics difficulties that were faced by his students with good time. Furthermore, not only this way encouraged those students in this classroom, but also I saw the interaction between all the students in the school.

After looking at the TV that was located outside the class and the image of sunshine, I entered this class, in which I found an interactive whiteboard, projector and one computer. When I turned my head on the wall side, I also found a large board to show the work and achievements of his students, which gave me a clear picture about the previous and current positive student achievements. In addition, I noticed that he used this panel with the idea of stars; that is, if any student has a positive progress in mathematics, the teacher puts a star under his star, and at the end of each week, the learner who collected more stars will get a reward from the teacher. I saw the positive effect on the students and their eagerness to get more stars, which lead to overcome the difficulties within a short time.

After looking at the wall, I turned my head to the seating arrangement which I found that this teacher had put them in a semi-circular arrangement. This method helped the teacher in controlling the class and observing their actions more easily. Please move to page 124 to find more on the description of the class and how he dealt with his students.

5.4.3.2 Information about the students in this classroom

It is interesting to mention that a large number of the students in this class had difficulties with the concept of multiplication. According to the teacher's evaluation sheet and my observations, I found that this difficulty differed from one student to another which I can divide it into two parts. The first is that some students imagined that the concept of multiplication is the same role of the concept of addition in terms of dealing with zero, which they think that any number multiplied by zero does not equal zero. I noticed even the teacher tried to clarify through IWB for them that any number multiplied by zero equals zero and they understood well. However, after two or three lessons when the teacher asked the students such as ten plus zero they answered zero. The second is that another set of students when multiplying 500 by 232 they directly dealt with the zero as subtraction rule and for which they borrowed from the next number. In addition, I noticed that two students in this class which the teacher did not tell me about them, when they dealt with subtraction task, they took a long time to answer to the teacher for $10 - 7$ or $8 - 4$; sometimes one of them took a long time and answered wrongly such as $20 - 13 = 5$, $10 - 7 = 6$ and $8 - 4 = 5$, which he answered with confidence.

Indeed, I noticed that there were four reasons of having this difficulty which resulted from the trouble in correctly understanding the role of zero in multiplication, incomplete knowledge, over generalization from addition and subtraction and memory problem.

Moving on to students' behaviour in the classroom, I noticed positively that they followed the teacher's rules very well. For instance, they put their mathematics book, notebook, pen and eraser on their table before the teacher came to the classroom, as he asked them. In addition, when the teacher, at the beginning of the classroom time, asked the students to look at the interactive whiteboard only, without opening the textbook, they would do so to focus with the teacher during his explanation of the lesson. On the other hand, when the teacher asked all students a question, I found that during some lessons three students would leave their places and go to the teacher's table and raise their hand, as they wanted to answer, even if they did not know the answer. Generally, the behaviour of students was positive; even those three students did that action as they saw enthusiasm and interaction from the teacher through the use of IWB. However, I see that this action will not give the opportunity to the rest of the students to participate.

5.4.3.3 The lessons for which this teacher tried to use technology and how

I noticed that the teacher used the IWB in every single mathematics lesson. As some of his students have difficulties with multiplication, I noticed that this teacher used Number Race software through the IWB to rebuild those students' confidence with addition, subtraction and multiplication concepts and to be able to reach to the concept of multiplication without difficulty or misunderstanding through this strong construction.

In the first week of my observations, I noticed that this teacher followed the book contents while providing lessons for students. The second chapter was about addition and subtraction. However, before the teacher begun with that chapter, he tried to review what they learned in the previous three years about the role of addition and subtraction with zero which took about two weeks as I mentioned earlier to build those students strongly to be able to overcome the difficulties they face in multiplication.

In the third week, the teacher begun to move gradually to chapter two and took the zero rule into consideration, which took two weeks. In the last two weeks from my observation, I found that the teacher ensured about their fully understanding of the chapter two and then moved to the third chapter which was about multiplication concepts.

In regard to how he used The Number Race software through the IWB in the first two weeks, I noticed that acutely students had to play a comparison game, in which there are two main screens. Each screen had a task such as 10 + 5 = 15 and 10 + 4 = 14. In this situation, the students had to carry out a numerical comparison task, choose the larger quantity, pick the screen with the larger quantity and finish the game within a specific time period. Each task was more difficult than the previous one, in which at higher levels, the student had to add or subtract in order to make a comparison, and at the end, the students could collect their reward and could start a new phase of play with a new character. Indeed, I noticed that IWB had greatly facilitated management of this program in terms of turning on and off, using the teacher figure to highlight any important point to make it clear for the students. This teacher also used the camera to take both photos and videos of those students while using the program.

It is interested to mention that in the last two weeks from my observations, the teacher used the PowerPoint presentations to connect what students learned through The Number Race software and multiplication concepts. Indeed, the teacher did a good action by taking all the pictures and videos in the first two weeks and added them in the PowerPoint program. For example, when the teacher started to open the first presentation, I found that video clip and pictures embody the students' participation during the first day of their use of that program, and then the teacher started to connect this video on the introduction of the multiplication concepts and so on. Indeed, I noticed that the content and the goal differed from day to day. However, the general idea of this use is that the teacher tried to connect the dealing with zero in addition, subtraction and multiplication at all slides. As a result, the students appeared to overcome the difficulties they faced in multiplication concepts and avoided misunderstanding; these slides seemed to help those students to connect and remember what was learned in zero rule in addition and subtraction lessons and about zero rule in multiplication.

During all the presentations, I noticed that the teacher tried to make the most from the positive features provided by this program, for instance, inserting an image and video from file or insert clip art, slide transitions with simple animation effects such as fading slides in and out, background effects, visual effects such as shading and beveling. All these advantages made his presentations more clear and interesting for those students.

5.4.3.4 The effects of technology on students with difficulties in multiplication

These effects are divided into three parts: the first is its effects on teaching, and the second is on learning in general and finally on overcoming the multiplication difficulties.

I noticed the positive impact of this tool on teaching. This included identifying students' strengths and weaknesses. For example, as we know that when students usually hear about technology and all its types, the first thing comes to their mind is fun. Therefore, I noticed that this teacher benefited from this point in terms of making all the students to participate enthusiastically through the use of this tool. This gave the teacher a quick opportunity to know the strengths and weaknesses of all the students in mathematics. As a result, it made it easier for the teacher to build those students mathematically in correct format after knowing the weaknesses of the students. It is important to mention that this effect was considered as a great positive impact on this teacher because two of the mathematics teachers in school B who did not use technology with their students reported to me that it was difficult to recognize the weaknesses of their students easily; as usually the students who had difficulties in mathematics felt embarrassed to raise their hands up in front of their friends to participate in answer any question that was asked by the teacher or if this student had any question to ask the teacher. This embarrassment led to accumulation of all the difficulties and misunderstandings in the students, which resulted to aggravation and continue of the difficulty in the next years of school. All these were because of the type of teaching method that made these difficulties to continue with those students without being discovered and solved.

Moving to the effects of this tool on learning mathematics generally, I noticed that it also appeared to have a positive effect on students in terms of improving and boosting their recall. For example, at the beginning of each lesson, the teacher did a quick review on the previous lesson, to ensure that the students understood the previous lesson well. This led him to build the new lesson on the previous lesson directly. The point that I wanted to make is that I noticed that all the students remembered the previous lesson and recalled the information easily, because when this teacher used IWB and tried to create a picture in the students' mind which made connections between the picture and mathematics tasks which resulted for students to remember the answer of tasks easily. For instance, on the first day of the third week, as usual the teacher asked the students about the previous lesson before he started the new lesson, and I was surprised that only five students raised their hands. The teacher then directly asked how about the rest of the students, whether they knew the answer, and why they did not raise their hands up. However, still the same five students raised their hands. After that I noticed that when the teacher connected this with the picture he had already provided at the previous lesson through IWB, and asked them whether they remembered that picture, amazingly, all the students raised their hands and wanted to answer that question.

Turning to the effect of IWB on learning multiplication particularly, I found that both The Number Race program and PowerPoint presentation also had positive effects on students. This appeared when I noticed that these helped those students in developing their confidence and being less hesitant while answering a question, which increased their capacity for mathematics and problem-solving, which resulted to overcome their difficulties in multiplication concepts.

5.4.3.5 The challenges faced during the use of technology

It is interesting to mention that I did not notice any obstacles that the teacher faced during his lessons while using the IWB. However, to give you indication from my observations, it is enough for me to say that this teacher used IWB daily in innovation and diverse ways such as The Number Race program, PowerPoint and TV. All this is because of his experience and qualifications. In addition, I did not want to forget his head teacher who had significant effect on the continuance of this teacher to use this tool with enthusiasm and determination, as this teacher mentioned during his interviews.

Overall, some of the third teacher’s students had difficulty in multiplication included some learners from 20 students who thought that any number multiplied by zero does not equal zero which is the same rule of the addition. Other students directly will borrow from the next number while multiplying 500 by 232. Two students took a long time while answering the task such as 10 − 7, and sometimes one of them took a long time and answered wrongly such as 20 − 13 = 5. However, as their teacher used IWB every day, particularly when he used The Number Race program and PowerPoint presentation through IWB, I noticed that these had positive effects on teaching, learning mathematics generally and learning multiplication especially. In teaching, the teacher gave a quick chance to identify the students’ strengths and weaknesses, which made easy for him to build those students correctly, and in learning mathematics generally, to improve and boost their recall. In learning multiplication, this tool was able to enhance the students’ confidence and did not hesitate while answering the teacher’s questions. Finally, it is important to mention that I did not notice any obstacles when the teacher used IWB.

Moving on to the researcher's observations on the other three mathematics teachers in school B without technology.

Session	Teacher four	Teacher five	Teacher six
Date:	○ 10/11/2014 – 25/12/2014.	○ 10/11/2014 – 25/12/2014.	○ 10/11/2014 – 25/12/2014.
Class level:	○ Year four.	○ Year five.	○ Year six.
Number of students:	○ 30.	○ 32.	○ 35.
Mathematics lesson on:	○ Subtraction.	○ Multiplication.	○ Multiplication.

The description of classroom generally.	○ There was one porcelain steel whiteboard. ○ The students' seats were arranged in the traditional row form. ○ The students did not occupy the same seat every day. ○ There was one desk and a chair for the teacher. ○ The classroom walls did not have any display boards. ○ The classroom had four small windows. ○ There was no storage area for the students' jackets and backpacks.	○ The teacher preferred to teach in the library. ○ The teacher carried a paperboard with him to explain the lessons. ○ The seating arrangement in the library consisted of one large table and numerous chairs around it. ○ There was one desk and a chair for the teacher. ○ The library had a large open space with large windows. ○ This library had a balanced collection of print and audio materials. ○ There were no technological tools available.	○ The students' seats were arranged in a traditional row form. ○ There was one porcelain steel whiteboard. ○ There was one desk and a chair for the teacher. He moved his desk to a corner of the classroom, and he put a box on the desk to hold a few spare pencils for when the students needed them. ○ There were four small windows in this classroom. ○ The walls were painted in white colour and there were no panels.
The description of classroom environment.	○ He was friendly, but strict when required.	○ He was friendly, but strict when required.	○ The teacher found it difficult to manage this classroom successfully. ○ He was very friendly with those students.
The areas of the difficulty in mathematics among students.	○ Borrowing from zero in subtraction calculations.	○ Understanding that any number multiplied by zero equals zero.	○ Understanding that any number multiplied by zero equals zero.
The teaching method.	○ Traditional method.	○ Traditional method.	○ He had previous experience with technology before and wanted to transfer it to benefit from its

			positive results. However, he used his laptop and the projector for only a week.
Its impact on teaching and learning mathematics.	○ There was wastage of the class time, without the main objective of the lesson being completed. ○ With regard to learning mathematics in general, this method does not provide incentives and enthusiasm to ease the difficulty of mathematics. ○ In facility mathematics difficulties, this method was unable to guide the students in the correct way, which resulted in the exacerbation of the difficulty instead of overcoming it.	○ Most students did not want to participate since this method did not stimulate them to raise their hand to interact with the teacher. ○ This method contributed to distract students' attention, as a result of which they found it difficult to understand the next lesson. ○ It was difficult for this teacher to help the students overcome difficulties, since he was unable to provide a lesson in a stimulating and entertaining way with this method.	○ During his usage of these tools, I noticed that this method saved class time, which allowed the students to practice with more examples. As a result, they could easily remember their lessons and this increased their self-confidence. ○ On the contrary, after his usage of these tools, I found the opposite of the above point. This led them to not remembering their lessons, and there was a decrease in their self-confidence.

Table 5.7: My observations of teachers who did not use technology

5.4.4 Teacher four

School: B without technology.
Date: 10/11/2014 – 25/12/2014
Number of the lessons: 30 lessons.
Each class period: 45 minutes.
Class level: Year four
Number of students: 30
Mathematics lesson on subtraction

5.4.4.1 The description of the classroom and my observations

When I entered this classroom, I found one porcelain steel whiteboard hanging on the wall that all students could see easily. The teacher used this board for writing the mathematics tasks, as this was only the way he could explain the lesson to the learners. After the teacher finished using the board, he would usually sit on his chair and place his hands on the desk. The chair and desk were situated in the corner, from where he could see the entire classroom.

Moving on, I observed that this teacher had organised the seating of the students so that each learner had an independent chair and table, arranged in a traditional row form. On the right side of the classroom, there were two rows, each comprising of five students; in the middle of the classroom, there were three rows of three students each, and on the left, there were two rows, one having five students and another having six. It is important to note that there was enough space to move between the rows on the right and the middle rows, and between the middle rows and the left rows. I noticed that the students sitting in the middle and back rows were more likely to lose focus and converse with their friends, which hindered their understanding of the lesson; and it became difficult for the teacher to observe them. For example, one day, while the teacher wrote on the board, two students sitting at the back were speaking with each other. When the teacher finished writing, he turned around, faced all the students, and asked them a question. The two students were still speaking with each other; when the teacher noticed them, he asked them to repeat the question he had asked. Both of them said they did not know, because they had not heard the question. The teacher scolded them for speaking with each other. The next day, in the beginning of the lesson, the teacher asked the same two students what the lesson was about yesterday, and they answered that they could not remember. This is despite the fact that this teacher was very strict with the students during the lessons. For more information, please refer to page 126.

5.4.4.2 Mathematics as a difficult subject for the students

During my visits to the classrooms, I noticed that some students faced difficulty in borrowing from zero in subtraction calculations. This issue became evident when some students wanted to subtract 1815 from 2004, which is the mathematics problem the teacher asked one of the students to answer. The student directly started with the thousands part and moved on to the right. For example, two minus one equals one, and move on zero minus eight equals eight. I noticed this when he answered zero minus eight as eight. The teacher asked this student to sit and he asked another learner to answer this task, who also continued to solve this task on the right. We continued with this case for up to six students. The seventh student said to the teacher, “No, this not correct, we must to start from the right and move to the left, such as four minus five”. However, when he began to solve four minus five and answered it as one, and moved on the left, which is zero minus one answered one. The teacher asked this student to stop, and he asked another student (i.e. the eighth student) to come to the board to continue solve this task. This student told the teacher that we could not subtract a small number from big number, which I noticed, made the teacher feel happy. However, when the student continued to speak and said that he had to take the zero (placed in the next number four), and put it beside the number four, which became 40.

I noticed that the students were negatively affected while completing expanded subtraction tasks. For instance, when the teacher asked some students to round 7542 to the nearest ten, they tried to avoid putting it as 7540, because they did not want to use the number zero; thus they answered the problem as 7549 or 7543. In addition, when the teacher also asked the students to round 36345 to the nearest thousand and then subtract it from 42543, some of them answered 36456 to avoid using the number zero.

It is interesting to mention also here observations about student behavior in general. I observed two types of behaviour. The first represents the negative side. I saw, in the first ten minutes of the some mathematics lessons, four students each two of who said these phrases: "Stand up, this is my place" and “Do not take this place." In addition, in some lessons when I entered the class, I noticed also that the teacher talked with those four students and said “why you were fighting with your friend this morning” and “Please, do not do it again.” The second represents the positive side, in which I noticed some students trying to mediate between those four students. Both cases reflected what I saw during 45 lessons. Meanwhile, the rest of students were very quiet and I did not notice any undesirable behaviour. Actually, the main reason for those four students fighting with each other was because the teacher asked all students not to occupy the same seat every day, and that a student who came first to class would have the priority of the place. However, two students of those four did not want to change their place as they feel uncomfortable if other learners take their places first. Also, the reason why I was able to note this behavior in students was that because most of the mathematics lessons in this classroom were the first lesson, from 7:15 am to 8:00 am, which made it easier for me to see what happened between those students.

5.4.4.3 Teaching methods and its impact on teaching and learning mathematics

With regard to the methods employed by this teacher to explain or teach, I noticed that the teacher used one method to explain the lesson during six weeks of my observations. At the beginning of the class, for 15 minutes, he turned his face towards the board and opened the mathematics book to copy the task from the book onto the board. When the teacher finished writing, he started to explain the lesson. The teacher did not complete his lessons at the end of class time, because I noticed that this method did not facilitate completion of the lesson within class hours.

Moreover, it was difficult for those students to know the goal of each lesson, because the teacher started to read the task on the board and solve it after 15 minutes. This is without knowing the goal of the lesson, or even connecting the previous lesson with the current one. I noticed the negative impacts that emerged from this method; these effects appeared in three aspects.

The first is its effect on teaching mathematics; this included waste of class time without completing the main objective of the lesson, which led to dispersion of the ideas of the students. The second was in learning mathematics; this method does not provide incentives and enthusiasm to ease the difficulty of the subject. The third was in removing the difficulty that students faced in subtraction; this method was unable to build those students in correct way, which resulted in an exacerbation of the difficulty.

Overall, it was clear that those students faced difficulty in understanding the subtraction concepts revolved around borrowing from zero. The teaching method followed by this teacher did not help the students overcome this difficulty. I noticed in this mathematics class that there was a lot of time being wasted without achieving the objective of the class. In learning mathematics, this method does not provide incentives and enthusiasm to ease the difficulty of the subject. Particularly, to overcome the difficulty they faced in subtraction concepts, which were unable to help those students to remove this difficulty, but helped increase it.

5.4.5 Teacher five

School: B without technology.
Date: 10/11/2014 - 25/12/2014
Number of the lessons: 30 lessons.
Each class period: 45 minutes
Class level: Year five
Number of students: 32
Mathematics lesson on multiplication

5.4.5.1 The description of the classroom and my observations

I noticed that in some lessons the teacher took his students to the school library. This library has four big windows which provided good light, ventilation, and view. So, when it rained, the teacher tried to stop teaching for five minutes, and began to speak with the students about nature, the atmosphere, and what clouds are and how they form. In addition, when the day was sunny, the teacher also tried to talk about how the sun works, and so on. It is clear that this teacher feels comfortable teaching in this library, and he is keen to benefit those students to learn about nature.

I noticed that the teacher carried a paperboard with him to explain the lesson on it. The seat arrangement in the library, which helped those students to be in one group, also caught my attention. In addition, there was one desk and a chair for the teacher, which he used some time to correct the students' homework. For more information on the contents of the library, the way the students moved from the classroom to the library and back, and how this teacher dealt with those students, please refer to page number 127.

5.4.5.2 Mathematics as a difficult subject for the students

With regard to the difficulties those students have with mathematics, I noticed that there were some students who had difficulties in understanding that any number multiplied by zero equals zero. This affected them in other aspects, such as they could not differentiate between dealing with the zero in the addition and the multiplication concepts. This resulted in an inability to solve the task properly, particularly while they were dealing with the distribution of property of multiplication over addition. For example, when the teacher asked them to solve the following task: each student pays three riyals to participate in a school trip, and if 42 students participate in this journey, use the distribution property to find all the money already paid by those students?

I found that students struggled a lot when they solved the previous example, because they dealt with two concepts in this task, i.e. multiplication and addition. They took a long time to answer such tasks, and this appeared when they began to answer the previous example. I found they started with correct steps, 3 x 43=3 x (40+3) and they moved on to the next step, which is (3 x 40) + (3 x 2). In the next step, some students struggled to solve 3 x 40, which they could not continue or tried to solve it with a wrong answer, which is 123. On the other hand, some students could not solve this step and the next step. For example, they found it difficult to understand how to deal with the zero in multiplication and addition. Therefore, when they reached this step (3 x 40) + (3 x 2), they found difficult to deal with 3x 40, and the next step, which is 120+6.

While it is true that the teacher went to the library for some lessons with those students and took them out of the classroom, I noticed the students enjoyed being out of the classroom. They raced to go to the place that the teacher asked them to go to. In addition, the way that the teacher dealt with those students during all lessons, which was moderate, which when the students were calm, he interacted with them as a friend. In addition, when they made noise, he was strict with them but without punishing them.

However, none of these tactics helped those students overcome the difficulties they have in understanding the multiplication concepts. This is because the traditional teaching method pursued by the teacher.

Moving on to the behaviour of the students, I did not notice any bad behaviour among the students; they were quiet and listened to what the teacher said to them.

5.4.5.3 Teaching methods and its impact on teaching and learning mathematics

In the library, I noticed that at the beginning, for five minutes, the teacher waited until the completion of the students’ number during their move from their class to the library or playground. The teacher also started to ask the students to come back to their class around five minutes before the end of class time. As a result, the teacher wasted about ten minutes from the original class time. Because of this, the teacher could not help those students to remove the difficulties in 35 minutes. This appeared when he started to write on the small paperboard with only one task as example to begin with, and he started to explain it for the students, which took about five to seven minutes. And then he asked the student to open their mathematics book. Five minutes before the end of the class, he chose some students to read the rest of the tasks and solve them. Most notably, I noticed that some students hid their faces from the teacher, because they not want to participate.

In the last week, I was curious to know why those students tried hiding from the teacher when the teacher asked the students who wanted to answer the task. Therefore, on Monday, I decided to ask the teacher about my observation, and he answered me that, "Believe me, I don't know the reason". I was surprised on Tuesday and at the beginning of the library time, the teacher asked the students about the reasons. One of those students reported,

> *As you know I have difficulty in mathematics and the way of reading the task and answer it, was not able to help me to understand the lesson well. Which result me to not be keen to participate in front of my friends, because I know I will answer wrong causing me embarrassment.*

He added,

> *My father pay for private teachers who come to our home to teach me what I learned already in school. For me, I found it very useful because that teacher teaches me through my ipad which help me to build the mathematics correctly and remember the concepts which led me to connect the previous information with current one.*

I was not surprised about the student's response, because I noticed the negative impact of that method used by the teacher in teaching and learning mathematics. With regard to its effect on teaching mathematics, I found that most students did not want to participate, since this method is not stimulating them to raise their hand to interact with the teacher. Moving to its effect on learning mathematics generally, this method contributed to distract the students' attention, which led them to difficulties in understanding the next lesson, because as we know, each lesson relies on the previous lesson. Concerning the effect of this method, particularly in overcoming the difficulties in understanding that any number multiplied by zero equals zero, I found that since this method was unable to provide a lesson in a stimulating and entertaining way, it is difficult for this teacher to help those students to overcome this difficulty in multiplication. This is despite the individual differences between those students, as they did not participate in class.

Considering all this, some students have difficulty in understanding that any number multiplied by zero equals zero. This led them to continue the difficulty even during the transition from one topic to another in mathematics, which became the mathematics complexity. I found that the teacher's teaching methods had a negative impact on teaching and learning mathematics. In teaching, which was not able to spread the spirit of interaction between students through participation leading to an inability to understand the lesson easily. Moreover, in learning math, generally I found that lack of students focus during the lessons that resulted in finding it difficult for the students to understand the next lessons. Finally, in learning that any number multiplied by zero equals zero, also I found it difficult for them to overcome the difficulty they face, because often the difficulty in mathematics arose from the teacher to facilitate and motivate students, instead of only asking them to read the tasks and answer them.

5.4.6 Teacher six

School: B without technology.
Date: 10/11/2014 - 25/12/2014
Number of the lessons: 30 lessons.
Each class period: 45 minutes.
Class level: Year six
Number of students: 35
Mathematics lesson on multiplication

5.4.6.1 The description of the classroom and my observations

As previously mentioned, the students' number in this classroom was 35. Therefore, it is an important to start my description of this classroom on how was the seats arrangement for those students. Indeed, when I looked into this classroom for the first time, I felt that this teacher was not going to do group work, discussions, or cooperative learning. This became evident when I found that each student was only was able to look at the backs of head their friends. The classroom had seven rows, two on the right side, three in the middle, and two on the left side, with each row having five students. This teacher allowed for any student to choose his seat not taking into account students who are taller or shorter. I found the students who sit in the front seats, particularly in row number one, three, four, five and six were taller than the students who sit behind them.

Which lead me now to describe the board that this class have, and students suffering from a clear vision.

This classroom had one porcelain steel whiteboard, which I noticed that some students who sit in the middle and the last seats were suffering from looking at the board to see what written by their teacher. Which I heard these words from some students said to the teacher such as “I cannot see”, or some other said to who sit on the front rows “could you please turn you head to right”, “turn your head to left” or “lower your head down”. As a result, after the first week, when the teacher explained some tasks on this board, the students found it difficult to understand what this teacher wrote in the board, which led them to not follow the teacher during the lesson, and eventually, did not understand the concepts of mathematics very well.

However, this did not give me a bad impression of this teacher, because I found that the teacher tried to help those students to overcome the difficulties they have in mathematics. This appeared when I noticed that this teacher carries with him his small-sized projectors and laptop, which he bought them from own salary. The teacher finishes with their use, he takes it with him at home, or put them in inside one of the drawers in his desk in this classroom.

This point led me to describe the teacher’s desk; I found that this teacher had put his desk in the corner, from where he could see all students clearly, and he put on the desk a box that held a few spare pencils the students could use when needed. Finally, moving to the windows and walls of the class, which I found were four small windows in this classroom, and the walls were painted white colour and without any panels.

5.4.6.2 Mathematics as a difficult subject for the students

It is important to mention that some students found it difficult to answer problems, such as “109 x 4”, which most of them did not know how to deal with zero. This manifested when they multiply four by zero and answered four, which as the final answer will be wrong. As a result, I noticed that this difficulty affected them negatively in understanding other concepts in mathematics, such as decimals, and the main reason was that this task has zero in it, and the teacher asked them to multiply. For example, when the teacher asked the students to answer “0.35 x1”, I noticed that some students stopped to answer the question because they did not know how to multiply one by zero.

Even the main reason for the teacher for giving this task to the students was to compare the answer for above task with “0.38”, in terms of which is bigger or smaller than the other. Thus, those students who did not understand the rule of decimals during the multiplication process, because they struggle or fail to understand that that any number multiplied by zero equals zero.

However, as we know from the teachers’ answers to my interview questions, this teacher taught in two schools before joining this school. He used IWB at the first school only, and he knew already the positive impact on those students, and the second, and at this school, he could not use technology because there is no technology available in both schools. Therefore, I noticed that this teacher was keen to use his personal laptop and small projector for a week while I was observing. Indeed, I asked this teacher why he did not use these technologies for all lessons with mathematics, because we could see its positive effect on his students. He answered because the head teacher discourages use of such technology with his students.

Turning to the behaviour of those students in this classroom, indeed I did not notice a big issue with these students.

5.4.6.3 Teaching method and its impact on teaching and learning mathematics

I observed how he used his laptop and the projector, and its effect on the students, compared not using these tools with using them. I noticed that in the first week, the teacher used his laptop and projector to help those students to overcome their difficulty in understanding that any number multiplied by zero equals zero. Indeed, I felt that this teacher has good ideas on how to use these tools effectively; this appeared when I saw his desktop on his laptop screen, on which I found many applications with a direct relationship with mathematics. When I asked him about these applications, he said he used these programs with his previous students at the first school where he taught.

However, I noticed that in one lesson the teacher tried to use one of his ideas when using these tools. This included turning the electronic copy book from his laptop through the projector to the whiteboard. Actually, I found this method had a positive effect on teaching and learning mathematics. This appeared when I saw that this way saved the class time, in terms of allowing him to give the students enough time to understand the lesson, and practice many examples that made them remember the lesson that led them to connect the previous lesson with current one easily.

During my observations from the second week to the end of last week, I noticed that he did not use these tools with his students, which I found had a negative impact on students' progress. This appeared when this teacher went back to the traditional method when he explained the lessons, which was for the first 15–20 minutes, when the teacher was busy typing the tasks on the board. After that, he started to explain the lessons to them, and the last 10 minutes he asked those students to transfer the answer from the board to their book, which I noticed with this method, the teacher wastes the class time writing on the board, which reflected negatively on students' learning. This did not allow them to practice the lesson more, to be easy to remember it and make them feel confident in terms of solving the task when they find it in upcoming lessons.

Overall, I can see from the above observations that some students have experience difficulty in understanding that the answer will be zero when you multiply any given number by zero. This difficulty led them to struggle to understand other areas in mathematics, such as decimals, because when they started to solve the task such as 0, 35 x1 directly they stopped as they did not know the result of one multiply by zero. As a result, they forgot the main goal of this task, which was to learn how to multiply decimals with whole numbers. Eventually, they found the difficulty worsened and did not find it easy to understand mathematics. However, as their teacher taught mathematics with technology before, he knew about its positive effect on his students. Therefore, he used his own laptop and projector for one week, and we saw its positive impact on teaching and learning math. This included saving the class time, which allowed those students to practise more tasks, which led them to remember and self-confidence when they solve this task in next lessons. Compared with the use of the traditional method without technology, which impacted negatively on those students. This was the main reason for this teacher not using these tools all lessons with his students, because the head teacher affected negatively on this teacher, which led him to not continue using these tools.

5.4.7 Summary of observations

I found from my observations that the three teachers who used the interactive whiteboard (IWB) with the students, each of them had used this tool for every single lesson. Each teacher used a different program through IWB; the first teacher used Mighty Mathematics Number Heroes program; and the second teacher used video camera, while the third teacher used the Number Race program and PowerPoint presentation. However, all of them agreed on one goal that helps their students with mathematics difficulties. Some students of teacher one and three had the same difficulty, which was that they failed to understand that any number multiplied by zero equals zero.

In addition, some students of teacher one faced certain difficulties, while students of teacher three had different difficulties. Some students with the first teacher found it difficult to understand that multiplication does not always make numbers bigger, and two students learning with teacher three found it difficult to deal with the subtraction task, such as 20 – 13, which they took too long to answer, and they answered it wrong. Some students of teacher two found it difficult to borrow from zero in subtraction. All these difficulties were easy to overcome through IWB, which I found has a positive effect on teaching and learning mathematics. Teacher one was able to use this tool to save the lessons and open it easily any time he needed. This demonstrated its ability to transform the state of students of mathematics from depression to liveliness, and built the confidence of the students.

The tools used by teacher two were able to save time in the classroom and reduce the negative outcomes caused by this difficulty, and expedite positive student response. The tools used by teacher three improved and boosted their working memory, and enhanced their confidence. They gave him a quick chance to identify the students' strengths and weaknesses. Finally, it is interesting to mention that these three teachers did not experience any challenges while using this tool, because of the positive relationship the school head teacher had with them.

Moving to the other three teachers in school 'B', I found that all of them did not use technology with their students, except teacher six who had experience with technology, and wanted to transfer it so that the students would benefit from its positive results. However, he used his laptop and the projector for one week only, because the head teacher did not encourage him to continue using these tools. Therefore, I noticed the results from using the traditional methods with those students, with mathematics difficulties arising after the first week. The students in level five and six had the same difficulties in understanding that any number multiplied by zero equals zero. While the students in level four had difficulties in borrowing from zero in subtraction. Thus, the traditional method did not succeed to overcome these difficulties faced by these students. In teacher four, this appeared when we saw how that method wasted class time without reaching the goal of the lesson, it did not provide incentives and enthusiasm to ease the difficulty of the subject, and increased the difficulties for the students, instead of reducing them.

In teacher five, there was no desire and interaction among those students during the lessons, no focus on current lesson which resulted in a lack of understanding upcoming lessons; their teacher focused on asking the students to read the task only rather than motivate them to solve, which led them to find it difficult to remove the difficulties.

Moving to teacher six, which I noticed two cases in this teacher, which is during and after using his laptop and the projector. During his class, he used these tools. I noticed that this method saved the class time that allowed for their students to practise with more examples, which resulted in them easily remembering and increasing their self-confidence. On the contrary, after he used these tools, I noticed that the students did not remember and this decreased their self-confidence.

5.5 Analysis and findings across the case studies (both from observations and interviews)

The results which emerged from each case study were compared with each other through the responses to the interview questions and the observations, which enabled the research questions to be addressed. These comparisons were divided into four categories, as follows:

5.5.1 Teaching approaches

5.5.1.1 Data analysis from the responses to the interviews

A number of key points emerged from the responses given by the teachers in school A, indicating that those teachers were keen to incorporate IWB into their teaching practice. These points are as follows:

This motivation was identified when teacher one reported that he wanted to take advantage of the rapid development of utilising technology for teaching students.

Teacher two, who had previously tried many methods to simplify the difficulties faced by students in learning mathematics, found that teaching with IWB made the subject more entertaining and less complex to grasp. Teacher three believed that in today's world students use technology outside of the school environment for entertainment; therefore, using these technologies inside the school would engage students' interest in learning mathematics, which, in turn, would lead them to be more willing and able to receive more information. I agree with what the teachers said because as we know that the students spending too much time on technology such as smartphones and tablets at their home, and I think that if we engage students through technology (regardless of the type of technology) in mathematics lessons, they will be more willing and enthusiastic to learn mathematics. However, I can tell they will enjoy but I can not tell they will learn any better. Not because they entertain mean they will learn mathematics better.

All three teachers mentioned that, since the recent developments in the mathematics curriculum introduced by the Ministry of Education, technology has become an integral part of the curriculum and has facilitated covering all the key mathematical concepts in the syllabus through IWB. This was confirmed by the responses of teacher two and teacher three who both agreed that before the development of mathematics curriculum, they had found difficulty in covering all the mathematics topics.

All the teachers were keen to attend a course on how they use IWB with students who struggle with mathematics, to exploit all of its advantages during their use with those students. They used IWB every day with their students; in addition, they wanted to show other teachers how they could use it each single lesson. For instance, teacher one mentioned that when the technology is perceived as supplemental to teaching practice rather than as a replacement, it is more acceptable to others. Teacher two added that the use of technology must become an integral part of everyday practice, similar to the use of textbooks and pencils. Teacher three believed that teaching mathematics with technology is very important, and in his view, there is great benefit to be derived from the development of the mathematics curriculum through the daily use of IWB. As a result, teacher three strongly recommends that all other mathematics teachers take advantage of the development of the mathematics curriculum, as technology is destined to become an integral part of every lesson with their students.

Moving to the other three teachers who teach without IWB in school B, although they knew the positive impact of IWB on teaching and learning on students who have difficulties in mathematics, they did not use it with their students because of the lack of encouragement and support from their head teacher. I can find this from their answers to the interview questions. Teacher four mentioned that he needs more encouragement to receive the required training and thereby demonstrate innovative teaching, while teacher five reported that a lack of director encouragement to provide help and support in removing the challenges faced by providing technology, appropriate training and technical support, reflected negatively on his decision. The final teacher added something interesting; this appeared when he stated the advanced age of head teachers and the lack of receiving in-service training. In his view, both factors may contribute to the head teachers' lack of enthusiasm about providing IWB at the schools, and their failure to encourage their staff to use technology, and these may lead teachers to not using these tools at schools.

5.5.1.2 Data analysis from the observations

I can noticed that teachers one and three used technology for more motivation, different practice and explanation, while teacher two tried to use a different representation to teach the students very specific aspects of mathematics, such as borrowing from zero in subtraction calculations. In addition, I can conclude that the ways in which teachers one and three used technology to help their students with misconception are more consistent with the constructivist approach to mathematics teaching. However, they may not always be the solution for a specific misconception; we sometimes need a representation to challenge or overcome a misconception directly. It is also interesting to mention that the use of technology not only helps in increasing practice and motivation, but also we use it to support constructivist and radical constructivist approaches when helping students regarding their misconceptions about mathematics.

I can also say that their current method of teaching students with difficulties in mathematics was dependent on technology in contrast with the three teachers in school B who use traditional teaching methods. They knew the benefits of teaching students with difficulties in mathematics using technology. Moreover, I can notice from their teaching methods that they did not use IWB, except for teacher six who used his laptop and projector for one week only, then returned to his usual method.

5.5.2 The effect of technology on students who have mathematics difficulties

5.5.2.1 Data analysis from interview responses

Starting with three teachers in school A, they agreed that using IWB can help students overcome mathematics difficulties; however, each teacher's answer was different from the others when I asked them to explain further regarding how IWB helps students learn.

Teacher one pointed out that the use of IWB draws the attention of students and boosts their motivation and aptitude in learning mathematics, particularly in the difficulty they face in multiplication. This teacher proved the efficacy of this method when we compared the students' grades in their reports before the teacher used the IWB and afterwards. I found that higher grades were achieved after the introduction of IWB, as the students became more motivated and engaged in the lessons. (Actually he showed me two exams for evaluating the students' performance in mathematics. The teachr used two exams in order to see the effect on students when technology is used and when it is not. He taught them with technology and then set an exam for them, then he taught them without technology and then set them an exam. Each exams include several types of questions such as true-false and multiple-choice). From the exam results I think that IWB helped those students in drawing their attention during the mathematics lessons, which led them to increase their motivation and aptitude in learning mathematics. As a result, they did very well in the exam compared with the other exam which was done before using technology.
Teacher two wanted to utilize the benefits of IWB in facilitating learning mathematics and for entertaining and engaging students. Ideally, he preferred to teach his students from year one continuing with them through to year six, as he believed that using IWB at the earliest stage was effective in preventing the negative consequences that resulted from the difficulties they faced in the first year. In addition, when teacher two mentioned the reasons behind some of his students' anxiety, I can see also that the cultural may have impact on students' learning mathematics, and this may cause to students to struggle in mathematics.

Teacher three who had some of his students who were lacking in confidence when they tried to learn multiplication, and also some others who struggled to remember the basic mathematical facts, such as the multiplication table. He had tried various teaching methods to help those students, and found that IWB had a positive impact on them. I think that confidence is very important, not only in learning but in all life such as interpersonal and so on. Therefore, the students who believe in their ability to do mathematics this will be led to enhance their ability to do it.

With regard to teachers four, five and six in school B who did not use technology, I can see from their educational background and work experience that they did not have the chance to teach mathematics with technology. Although teachers four and five believed that technology had positive impacts on students who experienced difficulties in learning mathematics, they themselves did not have any experience in working with technology. In comparison, teacher six had previously taught at two other schools and this was the first school that had any technology. Therefore, I decided to ask only this teacher the same questions that I had asked the three teachers at school A, who used technology in their classrooms, in order to take advantage of his previous experience. However, teachers four and five tried to answer the questions according to their own beliefs.

This appeared when teachers five and six agreed that we must exploit the students' enthusiasm for technology outside the school for fun and entertainment, and integrate it into their learning of mathematics within the school environment. As a result, this would make them enjoy learning mathematics and help change negative perceptions in those who believe that mathematics is difficult, while teacher four mentioned that technology would help facilitate students' learning through the new mathematics curriculum.

Teacher six added that IWB could help students with mathematics difficulties learn in two aspects:

> *The first is to enhance the teaching quality through improving the interaction, communication and collaboration levels; moreover, encouraging learning by increasing motivation and readiness of students to solve mathematical problems.*

5.5.2.2 Data analysis from the observations

During my observations of the three teachers in school A, I noted that all mathematics difficulties were easy to overcome through IWB, which I found had a positive effect in three areas: the first being its effects on teaching; the second, on learning mathematics in general, and the third, on overcoming specific mathematics difficulties.

I can say that the ways in which teachers one and three used technology to help their students with misconception are for more motivation, different practice and explanation. However, they may not always be the solution for a specific misconception; we sometimes need a representation to challenge or overcome a misconception directly. When looks at software that helps to use a different representation when teaching specific mathematics tasks, this helps students to make sense of the tasks, and I saw that during my observations of Teacher Two.

On the other hand, in school B, only teacher six out of the three teachers interviewed had any previous experience of using technology in the classroom. He was very enthusiastic about its use and wished to impart his knowledge to his students at the school. During my observations of his lessons, teacher six used a projector through his computer for the first week and for the remaining weeks, he returned to traditional teaching methods to deliver the information. This was due to the reluctance of the head teacher in the school to encourage him to continue using these tools. I noted two different outcomes regarding the teaching methods used by this teacher, during and after using his laptop and the projector. Firstly, I noted that using these tools saved class time, affording the students more time to practise and the teacher to offer more examples. This resulted in greater retention of the information and an increase in the students' self confidence. However, when he returned to traditional teaching methods, I noted that the students found it more difficult to retain the information and this decreased their self confidence.

In the case of teacher four, I noted that the traditional teaching method took longer reaching the goal of the lesson; the students were not engaged or interested in the subject of mathematics because this type of delivery presented it in a laborious way, and furthermore, actually added to their difficulties in mastering the topic. With regard to teacher five, there was no motivation or interaction among the students during the lessons, and no focus on current lesson which resulted in a lack of understanding the following lessons. Moreover, teacher five required his students to read the task only rather than motivating them to solve it, which did not help the students in solving the problem remove the difficulties.

5.5.3 The challenges faced with the use of technology

5.5.3.1 Data analysis from the interviews

Three sub-themes emerged from the interview responses: the first was to form an idea regarding the main reasons behind the decision of the mathematics teachers not to use IWB (Teachers themselves, school, government). The second sub-theme was to understand the major obstacles facing teachers when using IWB in terms of training teachers to use technology, technical support, and teacher attitudes and beliefs about teaching mathematics with technology). The third was to address and overcome these three major obstacles facing mathematics teachers during the use of IWB.

5.5.3.1.1 Teachers themselves, school or government

I can see from teacher responses that teacher one, three, four, five and six agreed that the main reasons behind the decision of the mathematics teacher to not use technology to help students with mathematics difficulties is school only. While teacher two defied the reason behind this blaming teachers themselves and school. Therefore, I notice that not one of them pointed to the Government as a reason behind the decision not to use technology, as the Saudi Arabian Government has made great efforts to improve the education system of the nation, which has included a continuous rise in the educational budget. This is also apparent in the Ten Year Plan 2004-2014, that has been released by the Saudi Ministry of Education, which covers development of infrastructure so that the technology could be easily implemented in the education.

5.5.3.1.2 Training teachers to use technology, technical support or teacher attitudes and beliefs

From the first three teachers' responses in school A, I can find a variety of views. Teacher one answered according to his study results that were conducted on the difference between teachers in school one equipped with IWB and other teachers in another school without IWB, identified the effect of mathematics teachers' attitudes on using IWB with those students who have difficulties in this subject. Teacher one found that all teachers in school one had a positive attitude regarding the use of IWB compared with other teachers in the other schools where some had negative attitudes towards the use of IWB. These included IWB did not encourage teachers to use discussion methods with their students, there was insufficient time during the class to use IWB effectively and there was no technology available when they had studied at university. Therefore, he believed that teacher attitudes and beliefs was the major obstacle facing teachers when using technology.

Teacher two perceived that the major obstacle facing mathematics teachers when using IWB with their students was the lack of training. He assured us by his example of when he was teaching at his previous school, he found that one of the teachers was lacked the necessary knowledge, skills and experience regarding technology. This impacted on him negatively during the lesson, as there were constant interruptions of technology that led to the lack of confidence when attempting to use it.

Teacher three believed that the lack of technical support was the major obstacle facing teachers when using technology. Thus, there is a relationship between the availability of technical assistance and obstacles to the use of technology. This appears if teachers are aware that there is no technical support in their school, as they feel that they would waste their time waiting for a solution to technical problems, which would result in them not completing the lesson, and would eventually discourage them from using technology in their classrooms.

Moving to the other three teachers in school B, I can identify from their responses that the attitude of the principal towards technology with regard to provision, integration and use in the classroom is the major obstacle to using technology with those students who have mathematics difficulties. Teacher four identified that, in the case of the attitude of the head teachers, advanced age and lack of knowledge regarding the potential and positive impact of technology on mathematics students may impact on its provision and the encouragement of teachers to use it. Teacher five identified that the attitudes of head teachers towards technology resulted from their lack of interest in the provision of technology and technical support in school, and, consequently the teachers lacked enthusiasm for attending training courses. Teacher six believed from his experience that the head teacher who is of advanced age, and has never received any in-service training regarding the positive impact of technology on education nor graduated in any computer subject had a direct influence on his attitude. Conversely, if the head teacher has been trained, it is enough to be open to new methods, and is familiar with the technology, this impacts on his attitude positively.

It clear that that from the interview responses above, I see the message that those three teachers in school A respectively want to send to us is as follows. The main obstacle facing teachers when using technology with those students who have difficulties with mathematics are: teacher attitudes and beliefs about teaching mathematics with technology, teacher training and technical support. However, the attitude of the Principal towards technology with regard to provision, integration and use in the classroom is the major obstacle to using technology with those students who have difficulties with mathematics. This what teachers in School B said. I can see how all the teachers in School B agreed in their answers that the attitude of the Principal towards technology is the main barrier to using technology, and although each teacher in School A provided different answers, I can say that the principals of both schools played a crucial role in managing the challenges they faced with IWB. This is because all these factors (teacher attitudes and beliefs about teaching mathematics with technology, teacher training and technical support) need continued support from the head teachers.

5.5.3.1.3 How can we overcome the previous three main obstacles?

With regard to training, I can find that all six teachers agreed that the head teacher is the only person who can initiate the necessary teacher training. The three teachers in school A gave us an example of how the principals introduced the necessary training. Teacher one believed that this was achieved through stimulating the teachers; teacher two, by making teacher evaluations, including regular attendance on training courses; and teacher three, by reducing or removing the extra workload on the teachers so they could attend training.

Moving to the technical support obstacle, all three teachers in school A agreed that their head teacher had a positive tangible impact on overcoming the obstacle of technical reforms. This appeared when I extracted from the interviews that he had allocated part of the budget received from the Ministry of Education to support his teachers in cases of technological malfunctions. The first and second teachers added that their head teacher has mastered the disposition of the use the budget made him unique, as he ensured they did not hear this term at all “it is not available in the school’’.

With regard to how the negative attitudes of teachers towards the use of technology can be overcome, I can learn from the three teachers in school A; teachers two and three agreed that we should provide appropriate training that focuses on hands-on practice rather than imparting verbal information. Furthermore, teacher one added that he would like to invite those teachers with a negative attitude towards technology to see for themselves the positive impact of technology through attending a lesson with another teacher who uses technology. However, the teachers in school B think that if the teachers discuss their need of technology and show them the advantages of the use it, this may help teachers to change head teachers' attitude.

5.5.3.2 Data analysis from the observations

I noted the reflection of the positive impact that support from the head teacher had on the three teachers in school A in terms of providing appropriate devices and programs, technical support, and teacher training, which led to the lack of challenges when they used the IWB. For example, when teacher one asked the principal for support with regard to implementing the program he received it directly on the second day. Also, regarding the provision of technical support, which appeared when the lamp of the projector burned out at the beginning of the class time, I noted two points. The first was the way this teacher dealt with the situation, which displayed a high level of confidence; the second was the speed and efficiency of the technical response in changing the lamp.

In contrast, regarding the three teachers in school B, I noted that the attitude of the head teachers towards IWB reflected on them in the provision and use of IWB within the classroom; this resulted in the negative effects on the teaching and learning of those students with mathematics difficulties, as previously mentioned; in spite of this, the teachers understood the positive impact that using IWB had on the teaching and learning process. Therefore, the challenge facing the three teachers was to dissuade their head teacher from his attitude toward IWB.

All six teachers agreed that the school context was the main reason behind the decision of the mathematics teacher to not use technology, except teacher two, who believed that the reasons depended on the teachers themselves, as well as the school. It is interesting to state here that all six teachers, when they said school, meant the principal, who plays a big role in the teachers' decisions, and is concentrated on their attitudes towards technology. With regard to the major obstacles facing teachers when using IWB, I found that the responses of the three teachers in school A using IWB varied from one another, and centered around teachers' negative attitudes and beliefs about teaching mathematics with technology, the lack of training in using technology, and the lack of technical support.

On the other hand, the three teachers in school B without IWB had the same answers in general, which cited the attitude of the head teacher towards technology with regard to providing, integrating and using it in the classroom. However, when each of them elaborated what they meant by the attitude of the head teacher according to his belief and experience, I noticed that they agreed on some points, such as when teachers four and six mentioned that the head teachers, who are advanced in age and lack knowledge about the effect of technology on students with difficulties in mathematics, are critical factors that may affect technology integration and use at schools. They also disagreed on some fronts, which appeared when teacher five mentioned the attitude of the head teacher in general without specifying, and when teacher six talked about the principal who did not graduate from computer subjects, influencing his beliefs and attitudes towards IWB. I also saw the keenness of the three teachers in school A, who advised other head teachers and teachers on how they overcame these three obstacles, trying to transfer their positive experiences with their head teacher in this aspect.

Turning to the observations, I noticed that the head teachers' attitude affected the challenges their teachers faced. In school A, he succeeded in encouraging and supporting his teachers in overcoming the difficulties they faced when using IWB, which led us to notice that the teachers did not face any challenges or difficulties during the use of IWB. That reflected positively on the teaching and the learning of students with difficulties. On the other hand, the head master in school B did not help his teachers overcome challenges to achieve their desires to take advantage of the positives of the use of IWB, which led to a lot of challenges when they taught their students, reflecting negatively on the teaching and learning of students with difficulties.

5.5.4 Mathematics difficulties

From my observations of the three teachers in school A with technology, I noticed that some students of teacher one and three had the same difficulty, which was that they failed to understand that any number multiplied by zero equals zero. In addition, some students of teacher one faced difficulties that differed from students of teacher three. Some students with the first teacher found it difficult to understand that multiplication does not always make numbers bigger, and two students learning with teacher three found it difficult to deal with the subtraction task, such as 20 – 13, which they took too long to answer, and they answered it wrong. Some students of teacher two found it difficult to borrow from zero in subtraction. Moving to the other three teachers in school B without technology, I found that some students of teacher five and six had the same difficulties in understanding that any number multiplied by zero equals zero. While some students learning with teacher four had difficulties in borrowing from zero in subtraction.

When I moved to the teachers' responses to my interviews, I could see in the next section their answers regarding their decision to use/not use technology for this lesson with students who have mathematics difficulties, which gave us a clear picture of the reasons for these difficulties, and the decision of teachers to use IWB.

5.5.4.1 The reasons for these difficulties and the decision of teachers to use technology

Teacher one noted that in year three, the teachers of some of his students had not used IWB to help them remember the mathematical concepts. This had impeded their mastery of the skills of multiplication facts, such as multiplying any number by zero equals zero. As a result, they found themselves facing further difficulties when learning more complex mathematical concepts linked to multiplication in year six. Therefore, teacher one always used IWB with his students, particularly in this topic to help prevent further difficulty in the middle stage.

Moving to teacher two, he identified three reasons that caused his students difficulty in subtraction; these were misconception of over-generalization from addition, failure to understand place value, and incorrect application of the subtraction procedure. He believed that these difficulties could be overcome through IWB, due to its ability to improve comprehension for students, and for linking the new information with the previous lesson to draw conclusions and form interpretations.

Teacher three used the Number Race program and PowerPoint presentation through IWB with his students who had difficulties in multiplication, as the students' learning is improved when corresponding words and pictures are used together, rather than words alone; this feature was available on these tools.

With regard to the other three teachers in school B, I found that teacher four mentioned that the reason for not using technology was that he needs more encouragement to receive the required training and thereby demonstrate innovative teaching; teacher five reported that there was no support or encouragement from the head teacher to help overcome the challenges by providing technology, suitable training and technical support.

Teacher six found from his experience of working in schools that advanced age, the lack of a university degree in computer subjects to help deal with technology, and the lack of in-service training regarding the positive effect of technology on students all may impacted on the head teachers' enthusiasm to provide and encourage teachers to use technology. All these factors may affect the head teacher, which reflects negatively on the teachers' decision to use technology.

I can see that some pupils under the first, third, fifth and sixth teachers had the same difficulty, which was that they failed to understand that any number multiplied by zero equals zero. In addition, there were differences between some learners under the first and third teachers with regard to the difficulties mentioned earlier. Some students with the second and fourth teachers also had the same difficulties, which centered on borrowing from zero in subtraction. In addition, it is clear from their interview answers that teachers one and two focus on the reasons for these difficulties and their decision to use IWB, while teacher three concentrates only on the reason of using this tool with his students. On the other hand, all three teachers in school B focus only on the causes of not using technology with students who have difficulties in mathematics, and mentioned nothing about the reasons for the difficulties that their students face. It appeared that the school's principal played a key role on their decision to not use IWB with students, despite their eagerness to acquire it to help students overcome their difficulties.

5.6 Answers to the research questions

1- Why are some mathematics teachers overcoming the obstacles they face when using technology to benefit their students?

I can answer this question through the three mathematics teachers in school A, who used IWB with their students that had mathematics difficulties. I found four main reasons that made these three teachers enthusiastic to overcome the obstacles they faced in the use of IWB.

The first reason given by teacher one was his desire to take advantage of recent technological developments in his teaching practice. Throughout his teaching career, teacher two had used various methods to attempt to address the difficulties his students faced while learning mathematics. He found that teaching with IWB facilitated learning through making the lessons more enjoyable and the topics easier to understand. According to teacher three, as technology is now so widely used for entertainment purposes by students in their daily lives outside of school hours, technology should be harnessed and applied to engage the students' interest within the classroom environment which would help stimulate their interest in the subject of mathematics, and also help them absorb the information more easily as a consequence.

The second is the way of structuring the topics after the development of the mathematics curriculum, which requires teachers to use technology to help them deliver and simplify information for students, as technology has now become an integral part of the curriculum.

The third is the teachers' belief that the IWB technology has a positive effect on teaching and learning students with mathematics difficulties; this was shown in the second section of the analysis above, entitled the effect of IWB on students who have mathematics difficulties.

The fourth is indeed a very important reason, that the help and support of the head teacher is critical for these three teachers to achieve all the three points above easily. These include the provision of IWB in each classroom through communicating with the Ministry of Education, encouraging teachers to use IWB, giving assistance and support to overcome all the obstacles that prevent their use of IWB, such as offering relevant training and technical support. The head teacher in their school was extremely supportive and enthusiastic towards IWB; he was very creative in offering ideas to help his teachers exceed the challenges and make the

most of the possibilities offered by IWB. For instance, encouraging teachers, and providing technical support in the school. All these factors led these three mathematics teachers to continue successfully in the use of IWB.
2- Why do some mathematics teachers not succeed in overcoming the obstacles that prevent them from using technology to benefit their students?
I can answer this question from the other three teachers in school B without IWB, who believed that the use of this technology in teaching had a positive effect on students who had mathematics difficulties. This was shown through their interview responses, mentioned in the second section of the analysis above, regarding the effect of IWB on students who experience mathematics difficulties. However, I found that there were reasons why the three teachers in school B did not succeed in overcoming the obstacles they faced with IWB. To identify these I need to revisit the analysis above, which appeared in four positions as follows: Firstly, I can find this in first section, when all the three teachers mentioned the reasons for not using IWB with their students. These included the lack of support from the principal in providing technology, appropriate training and technical support. Moreover, teacher three found that the advanced age of the head teachers, and also not receiving in-service training, may reduce the head teachers' enthusiasm about providing IWB at the schools, which may impact on teachers' decision to use technology. Secondly, I can see from the third section that all three teachers mentioned that the main reason behind their decision not to use technology to help students with mathematics difficulties was solely due to the school itself. By the term, school only, they were referring to the attitude of head teachers towards technology with regard to provision, integration and use within the classroom. Thirdly, each teacher mentioned the meaning of the attitude of head teacher according to his own belief and experience. I noticed that they agreed on certain points, such as when teachers four and six mentioned the advanced age of the head teachers and the lack of the directors' knowledge regarding the positive impact of technology on students with mathematics difficulties, which are critical factors that may affect technology integration and use at schools, but they disagreed on others. This appeared when teacher five mentioned the attitude of the head teacher in

general without further detail, and when teacher six added that the fact that the principal who have not graduated in a computer subjects would influence his belief and attitude toward IWB. Fourthly, it is clear from all the three points above that the attitude of their head teacher was the main reason for the teachers' own reluctance to overcome these barriers. Therefore, from this agreement in the teachers' answers and the examples I provided from my observations, I can say that the observations and perceptions, such as those I gathered, can be used to identify the causes and attribute effects to them.
Overall, I found from the interviews' responses of all six teachers and the consequent observations, that the head teacher's support was the main reason behind their decision to overcome or not overcome the obstacles they face when using IWB to help students with difficulties in mathematics. The principals of both schools played a crucial role in managing the challenges they faced with IWB. This became evident when the head master of school A helped the teachers in overcoming the obstacles they faced when using IWB by training teachers and through technical support, which reflected positively on teaching and learning mathematics, leading to a continued and enthusiastic use of IWB. On the other hand, the head teacher in school B did not help or support his teachers in providing IWB in school, nor help with overcoming the challenges they faced with IWB because of his attitude towards technology in general, which reflected negatively on their enthusiasm to continue to overcome barriers such as the provision of IWB in the school, and the lack of training and technical support, in spite of their belief that IWB has a positive impact on teaching and in the learning of students who have difficulties in mathematics.

Table 5.8: Answers to the research questions

5.7 Constructivism and Technology

It is interesting to mention in this section how technology can support a constructivist approach when teaching and learning mathematics. I can find the answer to this question through my findings in this study. For instance, as I mentioned earlier in the teachers' observations section that some of the third teacher's students have difficulty with multiplication, and I noticed that this teacher used Number Race software through the IWB to rebuild those students with addition and subtraction, and to be able to reach to the concept of multiplication without difficulty or misunderstanding through this strong construction. Actually, I noticed that IWB had greatly facilitated the dealing with this program in terms of turning on and off, using the teacher figure to highlight any important point in order to make it clear for the students. This teacher also used the camera to take both photos and videos of those students while using the program.

Indeed, the teacher built on this by taking all the pictures and videos in the first two weeks and added them to the PowerPoint program, to connect what students who learned through the Number Race software and multiplication concepts. For example, when the teacher started to open the first presentation, I found that video clip and pictures embody the students’ participation during the first day of their use of that program, and then the teacher started to connect this video with the introduction of the multiplication concepts and so on. Indeed, I noticed that the content and the goal differed from day to day. However, the general idea of this use is that the teacher tried to connect the dealing with zero in addition, subtraction and multiplication at all slides. As a result, the students overcame the difficulties they faced in multiplication concepts and moved from their misunderstanding. In addition, the final goal of these slides is to help those students to connect and remember what was learned in zero rule in addition and subtraction lessons and about zero rule in multiplication.

During all the presentations, I noticed that the teacher tried to make the most from the positive features provided by this program, for instance, inserting an image and video from file or inserting clip art, slide transitions with simple animation effects such as fading slides in and out, background effects, visual effects such as shading and bevelling. All these advantages made his presentations clearer and more interesting for those students. Therefore, overall I can say that I noticed the positive impact of these tools (the IWB, Number Race software, the PowerPoint program and the camera) on teaching and learning mathematics. In teaching, they gave the teacher a quick chance to identify the students’ strengths and weaknesses, which made it easy for him to build those students correctly, and in learning mathematics generally, they appeared to have a positive effect on students in terms of improving and boosting their recall. These tools were also able to enhance the students’ confidence and they did not hesitate when answering the teacher’s questions.

Moving on to a radical constructivist approach, which looks at software that helps to use a different representation when teaching specific mathematical tasks, helps students to make sense of the tasks. I can find this in the teaching method of Teacher Two, who tried to use the IWB with more creativity and innovation in subtraction lessons than in the remaining lessons, because some of his students did not understand how to borrow from zero in subtraction calculations. Indeed, as I noticed that when the teacher used the IWB with subtraction lessons, he tried to use something interesting with more effort. For instance, two days before the lesson, the teacher asked six students who had begun to overcome the difficulty of understanding the concept of subtraction to represent and embody subtract 352 from 500 in which the teacher put on the body of each one of them a poster paper with the number written on it. The first student represented the first zero on the right, the second one represented the second zero, the third student for number five and so on. It is important to mention that the teacher placed before those students the form of a real task so that under the student who represented the number zero on the right, was the student who represented the number two, and then under the student with number second zero was the student with number five, and so on. Then the teacher asked one of the students who had difficulty in understanding subtraction to go to the first student, who represented first zero and ask him “Can I subtract you on two?” He answered “No, it does not work. Please go to my neighbour and borrow from him and so on.” Eventually, the student reached to the student who represented number five, and he answered “Yes you can borrow one and take it to the next door ,which is number zero and so on.”

The teacher added some sound effects to this video through the IWB beneficiary of the huge potential offered by this tool. For instance, when the student moved from number zero to the next zero, I heard a knock sound and a fantastic word appeared from IWB, which gave more interaction and excitement among those students. As a result, I noticed three aspects of the effect of IWB on students. These included teaching by saving the teacher’s time, in learning mathematics generally by overcoming the challenges that arose from these difficulties, and in learning the concept of subtraction particularly by drawing the students’ attention that led them to like mathematics which resulted in their overcoming the difficulties they faced.

Based on the above, I can see clearly how technology can support constructivist and radical constructivist approaches when teaching and learning mathematics, and in the next chapter, I will discuss both approaches further.

5.8 The role of culture in learning mathematics

All the findings in this study suggest that each teacher has some students with mathematics difficulties. Actually, to link the impact of culture in students learning of mathematics, I returned to the responses to the interview questions section, which appeared clearly when asked teacher two in school A the following question: Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?

He mentioned to me before answering the above question that he preferred to move with his students from year one to year six. Because he believed that the first six years of a student life in school are a particularly sensitive period in learning and teaching mathematics. Therefore, when he is teaching these students from the first stage of education to the sixth stage, it will give him the opportunity for early intervention using the interactive whiteboard to avoid the persistence of negative results in the coming years. For example, he taught these students from year one to current year in year four. He added:

> *To answer your question, I will link the effect of early intervention with how IWB can help learners to learn mathematics, through this example. Some of my students faced mathematics anxiety when they were at year one that can impaired their development in mathematics. I asked those students individual the reasons behind their anxiety, which appeared to me that some of them were punished by their parents for failing to master a mathematical concept or being embarrassed in front of a sibling when failing to correctly complete a mathematics problem. And some others mentioned that before they begun the school, their family warning them of mathematics in terms of the difficulty and need to give more effort in order to succeed, this led to increased concern of mathematics and resulted to failure in mathematics.*

By linking the effect of early intervention with how IWB can help students to learn mathematics. He added:

The importance of early intervention with those students who have difficulty learning mathematics with the involvement of technology in this intervention, will benefit the students by reducing and eliminating the adverse results for students who experience mathematical difficulties, because this tool will make this subject more easy and entertaining.

To sum up, I can see that culture may have an effect on students' learning of mathematics, and this may cause students to struggle with mathematics; and their teacher tries to make this subject easier and entertaining to change their mind.

5.9 Summary

The data were analysed to investigate and understand the barriers that mathematics teachers face when using technology in their classroom in primary schools, and particularly why some overcame obstacles whilst others did not. Therefore, this chapter has reported the analysis of the data from the interview responses and observations of six mathematics teachers, followed by the research findings, which have enabled the research questions to be addressed.

Each response to the interview questions and the researcher's observations were detailed and summarized in the six tables. In addition, the teachers' responses and the researcher's observations were compared separately, and divided into four dimensions: teaching approaches, the effect of IWB on students who have difficulties in mathematics, and the challenges faced in the use of IWB and mathematics difficulties. Finally, all these four dimensions' results will be discussed in the subsequent chapter.

The structure of chapter six

The chapter has twelve sections following the introduction as follows:

6.1 Discussion of the result by dimensions

6.2 Constructivist and technology

6.3 The role of culture in learning mathematics

6.4 Theoretical framework

6.5 Summary of results

6.6 Overall case study methodology

6.7 The contribution

6.8 Reflexivity

6.9 Limitations of the study

6.10 Recommendations

6.11 Suggestions for further research

6.12 The conclusion of this chapter

Chapter six

Discussion and conclusion

6.0 Introduction

The chapter has twelve sections following the introduction as follows: Section 6.1 will discuss all the results that are obtained from the interview questions and researcher's observations, which will follow the same order and content as chapter five, including teaching approaches, the effect of technology on students who have difficulties with mathematics, the challenges faced in the use of IWB, and mathematics difficulties. Followed by constructivist and technology, and the role of culture in learning mathematics, which presents in 6.2 and 6.3 respectively. Section 6.4 will discuss the theoretical frameworks guiding this study. In addition, section 6.5 will offer a summary of the results, and section 6.6 will discuss case study methodology. Section 6.7 will present the contribution of the study, and section 6.8 will discuss the role of researcher reflexivity within the data gathering and analysis phase. Section 6.9 will present limitations of the study, followed by recommendations and suggestions for further research, which presents in 6.10 and 6.11 respectively. Finally, section 6.12, will present the conclusion of this research.

6.1 Discussion of the result by dimensions

This part discusses the findings concluded from answers to the interview questions, the observations and the literature according to four aspects: (A) teaching approaches; (B) the effect of technology on students who have mathematics difficulties; (C) the challenges faced with the use of IWB and (D) mathematics difficulties.

6.1.1 Teaching approaches

It is pertinent to mention the evidence that emerged from the responses of the interviews and the researcher's observations for the three teachers in school A, indicating that those teachers were keen to incorporate IWB into their teaching practice. These evidences are as follows:

Firstly, their responses were all positive regarding the question: Do you use technology in their classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology? However, the teachers presented three different reasons of their use of technology. The reason of using technology in teacher one was recent dramatic changes in technology in our society at a rapid rate. As a result, teachers should take advantage of the potential of new technology to benefit students. I can see these changes and developments in technology, particularly when I read in the literature what the research has identified regarding the history of using technology in mathematics education in the early part of the 20th century, and comparing it with recent technological developments. According to Reiser and Dempsey (2007), for example, in the early part of the 20th century, public schools used audio-visual aids such as charts, lantern slides and pictures to help students visualize object or problems. In 1913, Thomas Edison announced, "*Books will soon be obsolete in the schools. Scholars will soon be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture. Our school system will be completely changed in ten years*" (cited Saettler, 1990, p. 98).

Teacher two, who had previously tried many methods to simplify the difficulties faced by students in learning mathematics, found that teaching with IWB made the subject more entertaining and less complex to grasp. This concurs with Sarma and Ahmed (2013), who stated that, with respect to beliefs, mathematics, to most students, is a complex and difficult subject, involving language, space and quantity. Moreover, "*probably mathematics is the only subject which offers misunderstanding between teacher and pupil. The teacher stands at the blackboard. It is perfectly clear to him what the symbols mean and what conclusion can be drawn from them, but it may be completely otherwise with many of the pupils*" (Sarma & Ahmed, 2013, p. 409). However, when integrated with teaching techniques, technology can promote the translation of mathematical concepts from one mode into another, thereby making ideas more tangible (Suh et al., 2005).

Teacher three believed that in today's world students use technology outside of the school environment for entertainment; therefore, using these technologies inside the school would engage students' interest in learning mathematics, which, in turn, would facilitate their ability to receive more information (I add my opinion on pag 220). Also, Gutnik et al. (2011) and Rideout (2011) mentioned that students want to bring what they are doing outside school into classroom, such as computer games, smart phones, social networking and MP3 players (Gutnik et al., 2011; Rideout, 2011). According to Natalie (2011) as cited in FoxNews, 2011, "*we know that students live in technology* *outside the classroom. And we know that if we can spark interest in a subject through technology, students will be more willing to stretch their brains and try new things*" (p. 1).

Secondly, I actually agreed with the three teachers in School A when they pointed out that after the development of mathematics curriculum by the Ministry of Education, technology has become an integral part of the curriculum and has facilitated covering all the key mathematical concepts in the syllabus through IWB. This is because as well as technological development and the current technologically-based society, new systems of teaching and learning are being implemented in order to make progression in modern education. Therefore, the King Abdullah bin Abdulaziz Education Development Project (Tatweer) has as one of its aims to provide a new mathematics curriculum designed to integrate new technological developments. As a result, I can see teachers' enthusiasm to benefit from these developments and incorporate it into teaching and learning mathematics.

Thirdly, I can see that all three teachers were enthusiastic to attend any training programmes provided for them, to exploit all of its advantages during their use with those learners. This seem to be consistent with many researchers such as Jessica (2015), Akkaya (2016), whose found that technology will not enhance learning unless teachers have training on how to use it appropriately. It is interesting to see all the three teachers were very enthusiastic to attend any training sessions, because they want to be up to date with the technology which will lead them to take every advantage from technology. Actually, I understand the importance of training and I always encourage all teachers to attend training when possible, because another benefit of training is the improved communication between teachers stemming from the shared new information about technology, and I think this is a very valuable point.

Finally, I found from the responses of the interviews and the researcher's observations, that all three teachers used technology every day with their students. However, each one mentioned the way that helped him in the use of technology every classroom time, and want from new mathematics teachers to benefit from these experiences; for example, teacher one mentioned:

> *I know that in this school the teachers who have started using technological tools in their daily routine have a common concern and that is the time needed for*

> *planning and incorporating these tools in their daily lessons. Teachers believe that in adopting such equipment, much of their existing lesson plans have to be rewritten, however, these beliefs are but misconceptions.*

I asked him how do they address this misconception? He mentioned that when the technology is perceived as supplemental to teaching practice rather than as a replacement, it is more acceptable to others. In addition, I believe that when teachers take advantage of all the features offered by IWB, such as saving files and reopening them at any time, making changes, deletions or additions, this saves them time and effort. Furthermore, many researchers mentioned that, although lessons may take a little more time to prepare with an IWB (Glover & Miller, 2001; Greenwell, 2002; Levy, 2002; Ball, 2003), teachers report that when they manage their time correctly and take advantage of this technology (such as saving any changes or additions in the lesson materials to the computer, which they can re-use as needed), they find that they actually need less time to prepare lessons (Lee & Boyle, 2003). This emerged when one of the teachers interviewed by Levy (2002) asserted that lessons take a little more time to prepare with an IWB on the first occasion but "*all those resources that I prepared this year are now still there – I believe my work will be a lot easier from now onwards"* (p. 14). According to Glover and Miller (2001), teachers can save materials on IWBs as "*a means of teaching development based on reflections not just from lesson to lesson but also year to year*" (p. 263).

Moving to Teacher Two, with whom I agree that to help teachers to use technology, they should see it as another tool for learning such as pen and paper, and if they forget to bring these tools to the classroom, they will immediately feel that something missing in and that they cannot teach.Teacher three believed that teaching mathematics with technology is very importan, and in his view, there is great benefit to be derived from the development of the mathematics curriculum through the daily use of IWB. As a result, teacher three strongly recommends that all other mathematics teachers take advantage of the development of the mathematics curriculum, as technology is destined to become an integral part of every lesson with their students.

Regarding the other three teachers who teach without IWB in school B, although they knew the positive impact of IWB on teaching and learning on students who have difficulties in mathematics, they did not use it with their students because of the lack of encouragement and support from their head teacher. These barriers will be discussed in further detail in the section entitled: The challenges faced with the use of IWB.

6.1.2 The effect of technology on students who have mathematics difficulties

Teachers one and six agreed that IWB can increase levels of learners’ motivation and readiness. These findings also appear to concur with the results of other studies, such as those of (Hall & Higgins, 2005; Higgins et al., 2007; Shenton & Pagett, 2007; Smith et al., 2006; Smith et al., 2005; Thompson &Flecknoe, 2003), which emphasise that IWB has a positive effect on student motivation, and particularly in mathematics education (Torff & Tirotta, 2010; Taylor, 2009). I think that this effect is very important in learning and it will be useful if the teachers direct the students' interest, not just with a specific aim but towards further learning.

On the other hand, each of them held different views with regard to the effect of IWB on students who have mathematics difficulties. Teacher one said that it draws the attention of students, while teacher six added that it improved communication between teachers and students. These findings, obtained from interviewing the teachers, were also extended and supported by the researcher's observations. Therefore, I can show through my observations of teacher one that the use of IWB has positive effects on students’ attention; for instance, when the teacher finished explaining the whole lesson, usually 10 minutes before the end of class, he asked all students if they had any questions about the lesson. One or two of those students raised their hands, which meant they had questions. I noticed that in each class, the teacher asked one or two students from the rest of the learners that did not raise their hand, to go and help them answer their questions. The significant point here is that all students were competing to get a chance to help their friends; these appeared when I saw all the students’ hands rise wanted participation in helping. This means that IWB impacted positively on all the students’ attention, facilitating their understanding of the lesson and involving all the students in competing with confidence and enthusiasm. (This means that IWB had a positively effect on the attention of all the students, which led them to understand the lesson successfully and resulted in all the students competing with confidence and enthusiasm to provide assistance).

Teacher six implemented the same idea as teacher one with his students, but in a different way; for example, during my observations of teacher six from the second week to the end of the last week, I noticed that he did not use these tools with his students, which I found had a negative impact on his students' progress. This appeared when this teacher returned to the traditional method of explaining the topics. The significant point here is that in some lessons, during the last ten minutes, the teacher asked some students to provide the lesson that he had already explained to them, as he wanted to measure their understanding. I found that the majority of the students did not want to provide the lesson except for three students who raised their hands, as they wanted to participate. This may have been due to the fact that the majority did not understand the lesson sufficiently well, and hence, they lacked the confidence to give the lesson or explain what they had learned. It is interesting to note the differences between teacher one and teacher six; this lead me to see more from my observations on teacher six with regard to the effects of using technology and not using it to help his students who have mathematics difficulties.

I noted two different outcomes regarding the teaching methods used by this teacher, during and after using his laptop and the projector. Firstly, in a lesson during the first week, the teacher tried to use one of his ideas when using these tools. This included turning the electronic copy book from his laptop through the projector to the whiteboard. As a result, I noted that using these tools saved class time, affording the students more time to practise and the teacher to offer more examples. This led in greater retention of the information and an increase in the students' self confidence. However, when he returned to traditional teaching methods, I noted that in the initial 15–20 minutes of the class lesson, the teacher was always busy writing the tasks on the board. After that, he started to explain the task to them, and the in last 10 minutes he asked those students to transfer the answer from the board to their book; hence, the teacher wastes the class time writing on the board, which reflected negatively on the students' learning as it did not allow them time to practise the lesson more, to be easy to remember it and make them feel confident in terms of solving the task when they find it in upcoming lessons. These findings also agreed with Bidaki and Mobasheri (2013) who point out that IWB can save teacher time in classroom.

Furthermore, one benefit of using this tool, in the case of teacher one, was the time he saved during his class. These appear in many parts, but the most important one was when the teacher used the save feature of the lesson to be opened later at any time. This supported the teacher in the delivery of new information and linked it to the previous information easily, keeping his students familiar with all the concepts taught during his building blocks classes of basic mathematics, recalled by only a push of a button. Therefore, I believe that, when educators try to use all the features that are provided by IWB to save class time, this could significantly benefit his or her students. This was evidenced with the students of teacher one with regard to its effect on learning mathematics in general, this tool transformed the students' perception from feeling discouraged or disinterested in learning mathematics to active and stimulated engagement. In addition, on overcoming specific mathematics difficulties, particularly in learning multiplication concepts, IWB has a marked impact on improving students' self-confidence and memory recall. As those students had more time to practise what they had learned with more examples and tasks, they became more actively engaged and eventually memory recall became easier.

Before moving to teachers two and three, I feel it is important to discuss class size, which is considered one of the factors that should be taken into account. We know that in school A, there were 20 students in the classes of both teacher one and teacher two, while teacher three had 25 students. In contrast, in school B, teachers four, five and six had 30, 32 and 35 students respectively. This led us to seek an example of the effects of the use and non-use of technology in the classroom with a large number of students, which was the case with the class of teacher six. This teacher used a projector to increase the text size, which afforded students a better view of the board, resulting in better understanding and following of the teacher's directions during the lessons. Therefore, even in a class with a large number of students, positive effects of using technology were apparent. I can find this feature also with the use of IWB with regard to zoom the tasks on the board. I can also see the same effects arising from the use of IWB in all three teachers in school A. The teacher can exploit the IWB's versatility to move images or to zoom in when presenting the lesson, and can use a wide range of colours, all of which enhance the learning process (Damcott et al., 2000; Bell, 2002; Levy, 2002; Thomas, 2003).

Moving to teachers two and three, whose responses differed from each other: teacher two mentioned that the continuity of negative results could be avoided through early intervention by using technology such as IWB and computers. This is consistent with other researchers' findings, such as (Clements & Sarama, 2011; Ramey & Ramey, 1998), who showed that early interventions could help students with numeracy-related problems, through decreasing or preventing these difficulties that may occur at a later stage. In addition, a number of other studies have identified that Computer Assisted Intervention (CAI) is a useful tool for arithmetic support (Butterworth & Laurillard, 2010; Räsänen et al., 2009). While teacher three said that IWB can boost students' confidence and improve their memory. This concurs with the results of the study by Alabdulaziz (2013), who found that technology can boost students' confidence.

In this study, and during the researcher's observations, I noted that IWB also helped teacher three's students in building their confidence and improving their recall. According to Burden (2002), "*when I talk to the children about what helps them remember, they say they can still see the images in their mind, even after we have finished a lesson*" (p. 17). It is interesting to note that this tool gave teacher three the opportunity to identify the strengths and weaknesses of his students, leading him to encourage weaker students to have more confidence in solving mathematics tasks (please see the example on page 203). This finding appears consistent with that of Edwards, Hartnell and Martin (2002) who found that whole-class IWB activities gave mathematics teachers the opportunity to track their students' progress, which helped them to obtain diagnostic information about each pupil's strengths, misconceptions and weaknesses in mathematics. This provides a solid basis for the teacher to address problems before they worsen and become difficult to resolve.

In this study, this was considered as a great positive impact on this teacher because two of the mathematics teachers in school B who did not use technology with their students reported to me that it was difficult to recognize the difficulties of their students easily; as usually the students who had problems in mathematics felt embarrassed to raise their hands up in front of their friends to participate in answer any question that was asked by the teacher or if this student had any question to ask the teacher. This embarrassment led to accumulation of difficulties and misunderstandings in the students, which resulted continued of the difficulty in the next years of school. All these were because of the type of teaching method that made these difficulties to continue with those students without being discovered and solved.

As we know teacher three had a strong desire to capitalise on all the opportunities that were provided through using the many available technologies, such as the 42-inch TV hanging on the inner courtyard of the school; he also used the camera, the PowerPoint presentation and Number Race software through the IWB to assist his students who had difficulties in the concept of multiplication. Therefore, it is useful to discuss these other types of technology and their effects on those learners with difficulties in this area. To give an example, I noticed that this teacher put a picture and the name of the student who exceeded difficulty on the TV screen. Every week he placed a new name on the board, because the teacher wanted to give an opportunity for all students to compete, and this means we could see all students' names appear in each term. One day I tried to stand away from the TV to observe the students' reaction, particularly who are going through this tool. Indeed, I was stunned from what I saw and heard from some students such as I wish that instead of this student I will study to become better than him. Actually, I found that the teacher wanted to encourage students through TV to have positive competition to overcome the mathematics difficulties that were faced by his students with good time. Furthermore, not only this way encouraged those students in this classroom, but also I saw the interaction between all the students in the school.

From the first example given above, I believe that the use of the TV in this way can improve three skills in students, firstly, retaining information and remembering it more easily. Because as we know that television can combine visual images, sounds and spoken and written language at the same time, which led to retaining that information long enough to help them remember a picture and the name of the students who overcame difficulty, which maintained to the continuation of the competition, and eventually achieve the goals of the teacher. This concurs with Kozma (1991), who conducted a study on the impact of combining multiple systems and presenting them simultaneously, in which the researcher posited two main hypotheses; the first is that when TV-based information uses only audio and visual information, this may reduce the students' understanding, leading to not retaining information in the immediate memory. The second hypothesis is that when TV-based information uses multiple formats, such as visual images, sounds, spoken and written language, this may help pupils to remember and understand to a greater extent.

Secondly, using TV can also improve imagination skills; this appeared when some students imagined they were appearing on the screen instead of those students who appear on the screen, which led them to make positive progress. This is consistent with Gladkova (2013) who said that television exerts a powerful influence on cognitive skills, imagination and the task perseverance of children. Thirdly, I find that TV also improved reading skills in students; it is important to mention this point, as reading is one of the main academic focus areas in elementary schools, and teachers should build a solid foundation in helping students with their reading skills; there are many benefits to be gained from reading. However, the ability to read does not develop naturally, without careful instruction because some pupils do not develop the skills automatically or are not motivated to read. Conceivably, if we think that teacher three also uses the TV in class to encourage his students in mathematics 'reading', we should not forget the importance of reading mathematics symbols correctly, which, in turn, helps students to solve and understand the tasks easily. According to Borasi et al. (1998), who suggest that "*the key to successful reading of technical mathematics texts lies in the students' abilities to decode the mathematical symbols and language used in such texts so they can extract the information contained in the text and understand the concept or solve the problem*" (p. 277).

With regard to his use of The Number Race software through the IWB, in the first two weeks of my observations, the main purpose was to rebuild those students confidence with addition, subtraction and multiplication concepts and to be able to reach to the concept of multiplication without difficulty or misunderstanding through this strong construction. This appears consistent with that of Wilson et al. (2006), who focused on how technology can help students with mathematics difficulties. They used The Number Race software, which is designed for children, to teach and train them through entertaining numerical comparisons. After analysing the children's data through Matlab programs, they found that the software was successful and delivered the expected results, with the increases the children's performance on core number sense tasks.

Teacher three also used the PowerPoint presentations through the IWB; this appeared in the last two weeks from my observations, and was used to connect what students learned through The Number Race software and multiplication concepts. Indeed, the teacher did a good action by taking all the pictures and videos in the first two weeks and added them in the PowerPoint program. The general idea of this use is that the teacher tried to connect the dealing with zero in addition, subtraction and multiplication at all slides. As a result, the students appeared to overcome the difficulties they faced in multiplication concepts and avoided misunderstanding; these slides seemed to help those students to connect and remember what was learned in zero rule in addition and subtraction lessons and about zero rule in multiplication. This seems to be consistent with the result of Mayer and Anderson (1991) who conducted a study to compare teachers who presented information at school with words and pictures together, with other teachers who used words in preference to pictures. The researchers found that the teachers who presented information with words and pictures were more effective than those other teachers; the main reason being that the human brain processes information better when it is accompanied by images. Similarly, Peek (1987) focused on the effect of a PowerPoint presentation on the ability to retain information for the future. He found that it is easy to retain information relating to familiar concepts, but that it is difficult to retrieve information relating to unfamiliar or unclear concepts. As a result, he found that pictures and words together tend to improve memory retention in pupils.

Furthermore, during all the presentations, I noted that teacher three tried to make the most from the positive features provided by this program, to make his presentations more clear and interesting for his students. For example, inserting an image and video from file or insert clip art, slide transitions with simple animation effects such as fading slides in and out, background effects, visual effects such as shading and bevelling. However, many researchers have found that multimedia presentations do not show an increase in student performance in schools (e.g., Stoloff, 1995; Susskind, 2005; Szaba & Hastings, 2000). This is due to the fact that some teachers use PowerPoint in a way that inhibits interaction between the presenter and audience (Driessnack, 2005); moreover, some teachers limit the level of detail, making reading the slide a challenging activity (Driessnack, 2005). The latter leads to reducing the analytical quality of presentations (Stein, 2006). In this study, I did not find either case with this teacher; indeed, I found the opposite. This appeared when the teacher acted creatively by taking all the pictures and videos in the first two weeks and adding them into the PowerPoint program, which led to an increase in interaction between himself and his students, particularly when the students saw their pictures in the video recordings. The second case appeared when the teacher tried to connect dealing with the concepts of zero in addition, subtraction, and multiplication in all the slides, which helped his students remember what they had learned about the zero rule in the addition and subtraction lessons, and about the zero rule in multiplication. Therefore, I believe this teacher increased the analytical quality of his presentations in these two areas.

Moving to the other three mathematics teachers in school B; it was apparent from their educational background and work experience that they did not have the skills to deliver this method. Although teachers four and five believed that technology had positive impacts on students who experienced difficulties in learning mathematics, they themselves did not have any experience in working with technology. Therefore, I can see the effects of non-use of technology on students who have mathematics difficulties, which is the reverse of what I identified above with regard to the effect of the use of technology on teaching and learning mathematics. For instance, in the case of teacher four, I noted that the traditional teaching method took longer reaching the goal of the lesson; the students were not engaged or interested in the subject of mathematics because this type of delivery presented it in a laborious way, and furthermore, actually added to their difficulties in mastering the topic. With regard to teacher five, there was no motivation or interaction among the students during the lessons, and no focus on current lesson which resulted in a lack of understanding the following lessons. Moreover, teacher five required his students to read the task only rather than motivating them to solve it, which did not help the students in solving the problem remove the difficulties. One of those students reported,

> *As you know I have difficulty in mathematics and the way of reading the task and answer it, was not able to help me to understand the lesson well. Which result me to not be keen to participate in front of my friends, because I know I will answer wrong causing me embarrassment.*

He added,

> *My father pay for private teachers who come to our home to teach me what I learned already in school. For me, I found it very useful because that teacher teaches me through my ipad which help me to build the mathematics correctly and remember the concepts which led me to connect the previous information with current one.*

Overall, in regard to students' mathematical abilities, I can see from the observations above that in School A, the students mathematical abilities improved after using technology. I think from the above section, that I can see the link between the use of technology and mathematical understanding.

6.1.3 The challenges faced with the use of IWB

Teachers themselves, school or government

It is unsurprising to find that all six teachers did not include the Government as a reason behind the decision not to use technology, as the Saudi Arabian Government has made great efforts to improve the education system of the nation, which has included a continuous rise in the educational budget. This is also apparent in the Ten Year Plan 2004-2014, that has been released by the Saudi Ministry of Education, which covers development of infrastructure so that the technology could be easily implemented in the education. Therefore, they all agreed that the school context only was the main reason behind the decision of the mathematics teacher to not use technology, except teacher two, who believed that the reasons depended on the teachers themselves, as well as the school. It is interesting to state here that all six teachers, when they said school, meant the principal, who plays a big role in the teachers' decisions, and is concentrated on their attitudes towards technology.

These findings also appear to concur with (Kafyulilo et al., 2016, Mutohar, 2012), who emphasise that the role of the head teacher is vital to the successful adoption and utilisation of technology. Although Gibson (2002 cited in Smith-Salter, 2004) reported that it has not been long since the role of the head teacher in the integration of technology into school emerged; literature available on this specific role, which head teachers are expected to play, is scarce. In an endorsement of Gibson's view, Slowinski (2000) stated that the part that should be played by principals has been debated on a limited scale, at a time when the use of school computers, which represents a vital matter, transitions from a sheer issue of obtainability to a more essential one of how to achieve a productive incorporation of technology into taught curriculum. Nonetheless, it has been long since both researchers and practitioners established that, for a school to improve, it is important that attention is paid to the head teacher's role (Barth, 1980; Glickman, 1990; Howe, 1993).

6.1.3.1 Training teachers to use technology, technical support or teacher attitudes and beliefs

Teacher one believed that the major obstacle facing teachers when using technology with those students who have mathematics, is the attitude of teachers towards the use of technolog. This appears consistent with a number of studies in the literature review, including those of Norton et al. (2000), and Ertmer et al. (1999) who investigated the reasons why mathematics teachers did not use technology in their teaching to support students. They found that one of the reasons that prevented teachers from using it in their classes was their negative beliefs toward the use of technology. In addition, researchers suggest that the belief of the educator could serve as a crucial element in assisting or impeding the incorporation of technology by the educators (for example, Cuban et al., 2001; Dexter et al., 1999; Niederhauser & Stoddart, 2001; Windschitl & Sahl, 2002).

Teacher one believes that if teachers have a positive attitude regarding the use of the Interactive Whiteboard for the aims of education, then they will use it in class. However, if teachers have a negative attitude regarding the use of IWB, such as believing that the Interactive Whiteboard does not encourage teachers to use discussion methods with their students, which leads to lack of collaborative exchange of ideas among a teacher and students. In addition, some others may believe that the lack of time during class does not allow them to use technology effectively. Moreover, some may believe that there is no technology available when they study at University. This concurs with Handal (2004), who states that some teachers, while they were studying in schools or colleges, found that no technology was available to them. Thus, they tend to employ a certain pattern of teaching that obviates the need for technology.

Moving to teacher two who gave us a clear picture that the major obstacle facing mathematics teachers when using IWB with their students was the lack of training. This finding is consistent with many studies that have been reviewed to date (Alabdulaziz, 2013; Wachira & Keengwe ,2011). These studies found that one of the reasons that prevented teachers from using technology was the lack of training, as training teachers plays a crucial role in increasing the use and effectiveness of technology in education. Teacher two added IWB will not boost studying mathematics except for the teachers who are trained in the suitable use of the technology. In addition, many researchers, such as (Jessica, 2015; Akkaya, 2016) found that technology will not enhance learning unless teachers have appropriate training in how to use it appropriately. Consequently, teachers who have been trained effectively in the use of technology, and have enough expertise and skills in the utilization of computers, will have a positive impact on their students' progress. Teacher two also mentioned that this school has few teachers who during their studies at University were not trained to apply IWB in the classroom, but as those teachers understand that for students with learning problems using IWB can very effective, hence they try using technology for teaching their students. He assured us by his example of when he was teaching at his previous school, he found one of the teachers lacked the necessary knowledge, skills and experience regarding technology. This impacted on him negatively during the lesson, as there were constant interruptions because of technology that led to the lack of confidence when attempting to use it, and eventually to a decline in his motivation of its use. This concurs with Levy (2002), Glover & Miller (2001), who found the importance of training teacher to use technology.

Teacher three believes that the major obstacle facing teachers when using technology with those students who have mathematics difficulties is the lack of technical support. This finding appears consistent with Mumtaz (2000), Hsu (2016), and Alghamdi (2016) whose also found that one of the reasons why teachers did not use technology in their classroom was the lack of on-site support. According to teacher three, if there exists a lack of technical backing to be obtained in the school, then it is probable there will be a failure in implementing technical maintenance on a regular basis, which could lead to a greater risk of technical problems. This concurs with Jones (2004), who reported, "*if there is a lack of technical support available in a school, then it is likely that technical maintenance will not be carried out regularly, resulting in a higher risk of technical breakdowns*" (p.16). As a result, teachers would not use computers for teaching.

Moreover, there is a relationship between the availability of technical assistance and obstacles to the use of technology. This appears if teachers are aware that there is no technical support in their school, as they feel that they would waste their time waiting for a solution to technical problems, which would result in them not completing the lesson, and would eventually discourage them from using technology in their classrooms. This appears consistent with Jones (2004), who shares a similar view, that there is a close relationship between technical assistance and barriers; barriers in this case represent a lack of technical support, and teachers will be discouraged from using technology if they know that no one will be on hand to offer immediate technical support.

The breakdown of equipment, not to mention the issues of complexity, high risk of losing data, embarrassments and stress were all quite difficult for him to resolve. Otherwise, the tutors could easily disregard requirement to integrate technology, as they will waste too much time postponing their classes and awaiting a tangible solution to the technical problems. According to an example given by Butler and Sellbom (2002), it took three weeks to replace an expired projector bulb. In addition, Snoeyink and Ertmer (2001) found that teachers who tried to carry out a task on a computer, but who were unsuccessful due to technical problems, would then avoid using the computer for several days.

On the other hand, the three teachers in school B without IWB had the same answers in general, which cited the attitude of the head teacher towards technology with regard to providing, integrating and using it in the classroom. This was consistent with Baylor and Ritchie (2002), Atkins and Vasu (2000), who found that the principal's attitude toward technology played a key role in integrating technology in schools. However, when each of the teachers elaborated what they meant by the attitude of the head teacher according to his belief and experience, I noticed that they agreed on some points, such as when teachers four and six mentioned that the head teachers, who are advanced in age and lack knowledge about the effect of technology on students with difficulties in mathematics, are critical factors that may affect technology integration and use at schools. This concurs with the findings of Dawson and Rakes (2003); they believed that successful implementation of technology was dependent on the age and attitude of the principal. According to the researchers, the younger the principal, the more successful the implementation, and the older the principal (aged between 49-54 years) the greater the resistance to incorporating technology in the school. They also disagreed on some fronts, which appeared when teacher five mentioned the attitude of the head teacher in general without specifying, and when teacher six talked about the principal who did not graduate from computer subjects, influencing his beliefs and attitudes towards IWB.

It is interesting to note that teachers four and six agreed that there are two critical factors that may affect the head teachers' attitude towards technology integration and use at schools; these were: the principal's age, and the lack of knowledge regarding the effects of technology on students with difficulties in mathematics. Teacher six added a third factor, which was: if the principal had not graduated in computer subjects, this influenced his beliefs and attitudes towards technology. Bowman et al. (2001) stated that it is important that head teachers possess the knowledge and abilities needed to introduce technology which plays a role in providing support and training for educators to successfully incorporate technology.

Moreover, I noted the reflection of these influences on all six teachers; in school A, the positive attitude of the head teacher toward technology led to his active involvement in supporting his teachers in terms of providing appropriate devices and programs, technical support, and teacher training, which, in turn meant, the teachers did not face any challenges or difficulties when using IWB. For example, when teacher one asked the principal for support with regard to implementing the program, he received it directly on the second day. Also, regarding the provision of technical support, which appeared when the lamp of the projector burned out at the beginning of the class time, I noted two points. The first was the way this teacher dealt with the situation, which displayed a high level of confidence; the second was the speed and efficiency of the technical response in changing the lamp. On the other hand, the head master in school B did not help his teachers overcome challenges to achieve their desires to take advantage of the positives of the use of IWB, which led to a lot of challenges when they taught their students, reflected negatively on the teaching and learning of students with difficulties.

Before moving to the next section it is interesting to look back to the beginning of the previous chapter, particularly (overview information about each school, teacher and head teacher) to compare this information with the interviews and observations' examples that I discussed above in regard to the factors which follow; the possible effects of some teachers' enthusiasm for technology, of teachers' qualifications, of teachers' subjects, and class size. I can find that the improvement in students that I saw was in fact due to technology use and was not just the above factors. For example, in School A, there were 20 students in the classes of both teacher one and teacher two, while Teacher Three had 25 students. In contrast, in School B, teachers four, five and six had 30, 32 and 35 students respectively. I think there is a very big difference between the class sizes of teachers in schools A and B. However, I find that class size did not affect negatively on the improvement in Teacher Six students, because technology helped Teacher Six when teaching mathematics in terms of zooming the tasks on the board, which helped the students to see the board clearly and this led them to follow the teacher during the lesson. In addition, even when Teacher Six stopped using technology with his students, I do not think the class size had a negative effect on the students' improvement, because the teacher was able effectively to control his classroom.

In addition, with regard to the difference between all teachers' qualifications, I think there is no negative effect on teachers' enthusiasm for using technology, and this is what I heard from the teacher during the interview and from what I saw during the observation. Therefore, I can notice that all three teachers in School B only hold mathematics certificates. However, I can see their desire and enthusiasm to use technology if they have the chance to do that.

With regard to the description of the each school in the previous chapter, this information is, in fact it is very important for it to be in this study. This is because I think that in Government schools, the responsibility is with the Ministry of Education and the staff of the school, but in private schools the responsibility is with the owner of the school and the staff of the school under the supervision of the Ministry. Therefore, in this study both schools were public and not private, and this gave me an indication that in private schools maybe the barrier will be on the owner's side and not the on the head teachers.

In the next session, I will go on to discuss the difficulties with mathematics facing the students of all six teachers.

6.1.4 Mathematics difficulties

From my observations of the three teachers in school A with technology and the other three teachers in school B without technology, I noted that some students of teachers one, three, five and six had the same difficulty, which was that they failed to understand that any number multiplied by zero equals zero. This is consistent with Sadi (2007), and Rees and Barr (1984) who indicated that one of the most common difficulties facing students in learning multiplication, was their failure to realise that when they multiply by zero, the answer is zero. Moreover, some students of teacher one faced difficulties that differed from students of teacher three. Some students with the first teacher found it difficult to understand that multiplication does not always make numbers bigger, and two students learning with teacher three found it difficult to deal with the subtraction task, such as 20 – 13, which they took too long to answer, and they answered it wrong. This also concurs with Bell et al. (1981) who stated that there are other common difficulties among students when learning multiplication concepts, including their belief that “multiplication always makes bigger” and “division always makes smaller”.

I am surprised to see the same difficulty in some students in each teacher class (teachers one, three, five and six), which give an indication to know more about why this difficulty is exists in each of those classes. I think the reasons are as follows; trouble in correctly understanding the role of zero in multiplication, incomplete knowledge and over generalisation from addition.

It is interesting to note that when I observed the impact of teaching with technology and without technology on all students who had the same difficulty under the first, third, fifth and sixth teachers, I found that, in the case of the students of teachers one and three, their difficulty did not affect them in other topics in mathematics; this was because their teachers helped them through teaching with technology to overcome this difficulty at its root. In contrast, the students under the fifth and sixth tutors; their difficulty led them to have further difficulties in other mathematics topics; this was because the teaching method of their teachers, (without technology), did not help those students overcome this difficulty at its root, which, in turn, led to them having other difficulties in mathematics. The following example shows us how this difficulty negatively affects understanding other area in mathematics.

Some students of teacher five were affected in other aspects, such as they could not differentiate between dealing with the zero in the addition and the multiplication concepts. This resulted in an inability to solve the task properly, particularly while they were dealing with the distribution of property of multiplication over addition. This concurs with some researchers who found that many processes and can be obtained from multiplication, and that conceptual understandings can then be obtained from it (e.g., Harel & Confrey, 1994; Hiebert & Behr, 1988; Sowder et al., 1998). Therefore, multiplication is the most important operation to understand in mathematics (Ell et al., 2004).

Similarly, as can be seen in the previous chapter, I found that the students of teachers two and four had the same difficulty in subtraction, on borrowing from zero in subtraction, which was shown by Resnick (1982), and Sadi (2007) mentioned in the literature review chapter, where one of the most common difficulties facing students in learning arithmetic is borrowing in subtraction calculations. I think that the reasons of the students in primary school have this type of difficulty is over generalization from addition, not understanding place value and faulty procedure.

It is interesting to note that when I observed the impact of teaching with technology and without technology on all students who had the same difficulty under the second and fourth teachers, I found that, in the case of the students of teachers two, their difficulty did not affect them in other topics in mathematics; this was because their teachers helped them through teaching with technology to overcome this difficulty at its root. In contrast, the students under the fourth tutors; their difficulty led them to have further difficulties in other mathematics topics; this was because the teaching method of their teachers, (without technology), did not help those students overcome this difficulty at its root, which, in turn, led to them having other difficulties in mathematics. The following example shows us how this difficulty impacts negatively on understanding other area in mathematics. When the teacher asked some students to round 7542 to the nearest ten, they tried to avoid putting it as 7540, because they did not want to see the number zero; thus they answered the problem as 7549 or 7543. In addition, when the teacher also asked the students to round 36345 to the nearest thousand and then subtract it from 42543, some of them answered 36456 to avoid see the number zero.

6.2 Constructivist and technology

As I mentioned in the previous chapter, some of the third teacher's students had diffirent difficulties with the concept of multiplication. I can see that two students in the same classroom, of the same age and at the same time have different levels of understanding and provide different responses to instructional practices; this is because students come to formal education with different previous understanding that significantly influences the way they construct new mathematical knowledge (Ndlovu, 2013). This, in turn, affects their newly-acquired knowledge in mathematics.

Therefore, their teacher decided to use a constructivist approach with his students through the Number Race software to rebuild those students with addition, subtraction and multiplication concepts and to be able to reach to the concept of multiplication without difficulty or misunderstanding through this strong construction. Many researchers (e.g., Black & McClintock, 1995; Richards, 1998; Brush & Saye, 2000) have studied the effect of constructivism on classroom practice. In mathematics, constructivism has undoubtedly been a major theoretical influence in mathematics education (Steffe & Gale, 1995; Glasersfeld, 1991), and has contributed to the support of reform efforts in this field (National Council of Teachers of Mathematics, 1989). This theory has provided a deep and thorough understanding of learning and learners for mathematics educators, which has enabled teachers to know how students think and learn in mathematics education (Simon, 1995).

I also noticed that technology supported and facilitated the implementation of the constructivist approach. Researchers have suggested that technology can assist in implementing constructivist strategies (e.g., Duffy & Cunningham, 1996). As a result, there is a relationship between computer technologies and constructivism, through which the teacher can encourage collaborative learning and higher-level thinking, through the use of technology (Judson, 2006). Morrison et al. (1999) state: There is no need for technology and constructivism to be in conflict. When we perceive computers as problem-solving tools, rather than simply a method to input a command, these reforms can have an impact on the utilisation of technology, which, in turn, can have an impact of educational reform.

Also I can see the positive impact of this tool and the constructivist approach on teaching and learning mathematics. This included identifying students' strengths and weaknesses. It is important to mention that this effect was considered as a great positive impact on this teacher because two of the mathematics teachers in school B who did not use technology with their students reported to me that it was difficult to recognize the weaknesses of their students easily; as usually the students who had difficulties in mathematics felt embarrassed to raise their hands up in front of their friends to participate in answer any question that was asked by the teacher or if this student had any question to ask the teacher. This embarrassment led to accumulation of all the difficulties and misunderstandings in the students, which resulted to aggravation and continue of the difficulty in the next years of school. All these were because of the type of teaching method that made these difficulties to continue with those students without being discovered and solved.

Moving to the effects of this tool on learning mathematics, I noticed that it appeared to help those students in developing their confidence and being less hesitant while answering a question. In addition, it also appeared to have a positive effect on students in terms of improving and boosting their recall. For example, at the beginning of each lesson, the teacher did a quick review on the previous lesson, to ensure that the students understood the previous lesson well. This led him to build the new lesson on the previous lesson directly. The point that I wanted to make is that I noticed that all the students remembered the previous lesson and recalled the information easily, because when this teacher used IWB and tried to create a picture in the students' mind which made connections between the picture and mathematics tasks which resulted for students to remember the answer of tasks easily.

This appears consistent with Cobb (1988) who stated that mathematics educators should not transfer information into pupils' heads, but those students should construct their own understanding themselves. According to Ellerton and Clements (1992), knowledge of mathematics is what students create themselves by actively searching and forming mental links, rather than something received as a result of studying textbooks or following the words of teachers. When people make active connections between dimensions of their social and physical environments and a number of numerical, spatial and logical concepts, they often acquire an understanding of 'ownership'. Thus, the role of mathematics educators in this position is to facilitate cognitive restructuring and conceptual reorganization. This widely-held assumption will lead to students' cognitive development when their previous knowledge is revised to make it compatible with new information (Cobb, 1988).

Turning to teacher two who tried to use the IWB with more creativity and innovation in subtraction lesson than the remaining lessons, which led him to use different representation for teaching very specific aspects. For example, some of his students have difficulties in subtraction which is divided into two parts. The first comprised some students who had difficulties when borrowing from zero in subtraction calculations, for example, when they have to subtract 352 from 500. The second is some others who avoid the first difficulty by starting from $5 - 3$ and then $0 - 5$ and $0 - 2$ when they subtract 352 from 500, and the difficulty became more complex for them because they wanted to avoid dealing with the zero at the beginning of the task, and they made a mistake when they start to solve the task on the left side instead of right side. In addition, I noticed that when some of those students reach to solve $0 - 5$ and $0 - 2$, they answered 5 and 2, and some others stopped solving with a big question mark in their face.

Therefore, the teacher asked six students to represent and embody subtract 352 from 500 in which the teacher put on the body of each one of them a poster paper with the number written on it. During this presentation the teacher started to record video by camera, and then he added some sound effects on this video through IWB beneficiary of the huge potential offered by this tool. This method drew the students' attention that led them to like mathematics which resulted to overcome the difficulties they faced.

Based on the previous chapter and the discussion above, I can conclude that teachers one and three used technology for more motivation, different practice and explanation, while teacher two tried to use a different representation to teach the students very specific aspects of mathematics, such as borrowing from zero in subtraction calculations. In addition, I can conclude that the ways in which teachers one and three used technology to help their students with misconception are more consistent with the literature on the constructivist approach to mathematics teaching. However, they may not always be the solution for a specific misconception; we sometimes need a representation to challenge or overcome a misconception directly. It is also interesting to mention that the use of technology not only helps in increasing practice and motivation, but also we use it to support constructivist and radical constructivist approaches when helping students regarding their misconceptions about mathematics.

6.3 The role of culture in learning mathematics

Tecaher two noticed that a number of his students suffered from anxiety in relation to mathematics at year one, something that could have damaged their progress with the learning of mathematics. This agrees with Richardson and Suinn (1972), and Suinn et al. (1988) who stated that mathematics anxiety may contributes to difficulties in manipulating numbers and solving mathematical problems in academic and social situations. Therefore, mathematics anxiety is clearly a significant cause of poor performance in mathematics (Das & Das, 2013).

It is interesting to mention that there are some researchers who reported some of the reasons that cause students to develop mathematics anxiety. For instance, Newstead

(1995) highlights that there is a lack of consensus regarding the origins of mathematics anxiety among children. He considers possible causes including the teacher's anxiety, features of the social or educational environment, the inherent nature of mathematics, a history of poor performance, and the effects of pre-school experiences of mathematics. In addition, Tobias (1978) and Stodolsky (1985) demonstrate that it is well documented that the anxiety frequently originates from negative experiences in the classroom.

However, when teacher two mentioned the reasons behind some of his students' anxiety, he believed that a number of students received punishment from parents after they were unable to become completely proficient in a certain mathematical concept, or suffered embarrassment in front of a sibling over being unable to solve a mathematics problem correctly. A number of other students stated that before starting school, their parents gave them a warning that mathematics is a difficult subject that needs to be dedicated more attention to be passed; this warning created a higher level of worry about mathematics, and eventually led to failing in mathematics. It gave the indication that the reason that may cause some students to develop mathematics anxiety is 'some of parents' culture', which eventually led those students to have difficulties with mathematics.

In other words, I can see that the cultural may have impact on students' learning mathematics, and this may cause to students to struggle in mathematics. It has been established that culture represents a factor that has a powerful impact in mathematics learning and teaching (Wang & Wu, 2010). Barrett (1984) defines culture as "the body of learned beliefs, traditions, and guides for behavior that are shared among members of any human society" (p.54). In understanding the role of culture in mathematics education, defining what culture means in mathematics education is vital. In the view of Leung et al. (2006), "Culture refers essentially to values and beliefs, especially those values and beliefs which are related to education, mathematics or mathematics education" (P.4).

6.4 Theoretical framework

6.4.1 The Concerns-Based Adoption Model (CBAM)

CBAM is considered essential for the empowerment of individuals who can bring changes in the settings of education (Sashkin & Ergermeier, 1993). In this many concerns that faced the three mathematics teachers in school B without technology (see Table 6.1).

CBAM model	Examples
Teaching approaches	○ Teacher four mentioned that he needs more encouragement to receive the required training and thereby demonstrate innovative teaching. ○ While teacher five reported that a lack of director encouragement to provide help and support in removing the challenges faced by providing technology, appropriate training and technical support, reflected negatively on his decision. ❖ The final teacher added something interesting; this appeared when he stated the advanced age of head teachers and the lack of receiving in-service training. In his view, both factors may contribute to the head teachers' lack of enthusiasm about providing IWB at the schools, and their failure to encourage their staff to use technology, and these may lead teachers to not using these tools at schools. ❖ I found many concerns facing the three teachers who teach without technology in school B. Included the lack of directorial encouragement, and the effects of the age factor and the in-service training of the head teachers in facilitating efforts towards integrating technology in schools.
The challenges faced with the use of technology	○ In school A, the head teacher succeeded in encouraging and supporting his teachers in overcoming the difficulties they faced when using IWB, which led us to notice that the teachers did not face any challenges or difficulties during the use of IWB. That reflected positively on the teaching and the learning of students with difficulties. ○ On the other hand, the head teacher in school B did not help his teachers overcome challenges to achieve their desires to take advantage of the positives of the use of technology, which led to a lot of challenges when they taught their students, reflecting negatively on the teaching and learning of students with difficulties. Therefore, all three teachers tried to discuss the importance of the use of technology in mathematics, particularly with students who have difficulties with mathematics. Therefore, they think that if the teachers discuss their need of technology and show the advantages of using it, this may help them to change head teachers' attitudes. ❖ I noticed that the head teachers' attitude affected the challenges their teachers faced.
The three teachers in school B understood the importance of	○ Teacher four pointed out that: *As you observed during my teaching in the classroom with those students who are suffering day after day from the mathematics, because my teaching methods are not in line with the new mathematics curriculum, which was developed by*

technology	*the Ministry of Education, these are important issues. We see that presenting the curriculum for students needs to be augmented by technology to facilitate students' learning of mathematics, before aggravating the problem and then leading to a situation that cannot be controlled.* ○ Teacher five and six seemed upset because they do not use technology with their students. They both agreed that the students have access to technology to entertain themselves outside the classroom, and they know that mathematics is difficult subject for students (I add my view on this point on page 220). To make mathematics easier and address their misconceptions, we must, as educators, seize opportunity from their love of technology and merge it with the subject of mathematics, which will lead to future student perceptions that mathematics is not difficult. Teacher five added: *I hope to hear soon that technology will be used in this school, because the benefits of it are clear to us as teachers. This was apparent when a competition in mathematics took place between some of the students of this school and some of the students from another school. When we found, at the end of competition, that the students in other school outperformed our students by degrees, we were disappointed.* ○ I asked teacher six about this competition and his opinion on the results of the students and the reasons for the low grades of their students. He reported out that: *Yes, there was a competition between our school students and students from other schools in mathematics. The competition was dependent on agility and intelligence. I was surprised at the results of the competition which found that their students surpassed our students to a significant degree. When I met with their mathematics teacher, I asked him about their secret and he told me proudly, 'I use smart interactive whiteboard with my students which made them come to love mathematics and do exceedingly well in competitions'. After that it came to my mind to ask each teacher the following question to try helping the stakeholders find suitable solutions for those teachers.* ❖ I can find that the three teachers in school B understood the positive impact of technology on teaching and learning on students who have difficulties in mathematics, and this appeared in their responses in the interviews.
Teacher six tried to use technology with his students	○ Teacher six was keen to use his personal laptop and small projector for a week while I was observing. Indeed, I asked this teacher why he did not use these technologies for all lessons with mathematics, because I could see its positive effect on his students. He answered because the head teacher discourages use of such technology with his students.
The effect of teaching	○ I noticed that the traditional method used by teachers four and six could be an inefficient use class time.

without technology on students who have mathematics difficulties	○ Some of the students under teacher four disliked mathematics, thus increasing the difficulties. ○ Some students of teacher six found their recall process to be difficult, resulting in a decline in their self-confidence. ○ In teacher five, I found a lack of interaction, motivation and focus during the lesson. ❖ I found negative aspects of practice on students as teaching without technology such as wasting class time, disliking mathematics, difficulties with the recall process and lack of interaction, motivation and focus during the lesson.

Table 6.1: Discussion the first theory

6.4.2 The Technological Pedagogical Content Knowledge (TPCK)

To make the name easier to remember, TPCK framework was renamed TPACK. It also created a more unified structure for technology, pedagogy, and content, which are the three main kinds of knowledge that were addressed (Thompson & Mishra, 2007–2008). Teachers need a deep understanding of mathematics (content), the process of learning and teaching (pedagogy), and technology in order to be prepared to teach mathematics (Niess, 2006).

In this study, technological pedagogical content knowledge was found to be an important influence in understanding the needs of mathematics teachers for effective pedagogical practice in technology to help those students with mathematics difficulties (see Table 6.2).

TPACK model	Examples
Technology knowledge (TK)	○ Teacher one attended various training courses including the use of technology in mathematics education – Towards Technology Integration in Mathematics Education, and the role of technology in teaching and learning mathematics. ○ Teacher two attended some of the training courses about the use of technology in education, and the reason why he attended these courses was to understand computer systems at a deeper level and to be able to help those students to who find it difficult to learn mathematics. ○ While teacher three also attended various training courses about the use of technology in mathematics education. ❖ I can find that those three mathematics teachers in school A have the skills required to operate these technologies. The courses these teachers attended enabled them to use technology easily and creatively to help their learners with mathematics difficulties.

Pedagogical knowledge (PK)	o Teacher one, some of his students had difficulties with basic multiplication. Therefore, in first four weeks, he attempted to help them overcome these difficulties before moving to another topic at the beginning of week five. However, in the first five minutes of each lesson, he helped them review and remember what they had learned in the previous four weeks. o With regard to teacher two, who had some students with subtraction difficulties that he wanted to address, he started with topics based on the contents in the mathematics book, concentrating on the addition and subtraction chapter, which took two and a half weeks to complete. After these weeks up to the final day of my observations, he moved on to the other chapter, while continuing to review and simplify the previous chapter for those students who still needed more help to overcome their difficulties, which led them to feel more confident with other topics that are based on subtraction. o While some of the teacher three's students were experiencing difficulties in multiplication, generally, in the first week, he followed the book contents, which was the second chapter focusing on addition and subtraction. He planned to review the role of addition and subtraction with zero for about two weeks before starting the chapter, to link it to the difficulties they had encountered regarding multiplication. In the third and fourth weeks, he moved to the second chapter, and in the final two weeks, to the third chapter, which focused on multiplication concepts. ❖ I can see from above that teachers one, two and three whose teaching approaches focused on continuous review that helped their students to remember.
Content Knowledge (CK)	o I can find that all teachers have a good knowledge about priority mathematical topics to be learned or taught, and they know also the main difficulty that made some students of teacher five and six struggle with other area in mathematics. Except teacher four who was not able to teach mathematics very well.
Technological Content Knowledge (TCK)	o I can find this in teachers one, two and three who have a good understanding of mathematics content knowledge and the skills required to operate and use the technologies to help their students with mathematics difficulties, and these two elements helped their students to avoid further difficulties in other mathematics topics. o In contrast, the students under the fourth, fifth and sixth tutors; their difficulty led them to have further difficulties in other mathematics topics; this was because the teaching method of their teachers, (without technology), did not help those students overcome this difficulty at its root, which, in turn, led to them having other difficulties in mathematics.

	○ The following example shows us how this difficulty negatively affects understanding other area in mathematics. The students of teacher five were affected in other aspects, such as they could not differentiate between dealing with the zero in the addition and the multiplication concepts. This resulted in an inability to solve the task properly, particularly while they were dealing with the distribution of property of multiplication over addition. For example, when the teacher asked them to solve the following task: each student pays three riyals to participate in a school trip, and if 42 students participate in this journey, use the distribution property to find all the money already paid by those students? I found that students struggle a lot when they solved the previous example, because they dealt with two concepts in this task, i.e. multiplication and addition. They took a long time to answer such tasks, and this appeared when they began to answer the previous example. ❖ The above example shows us how this difficulty negatively affects understanding other area in mathematics.
Technological Pedagogical Knowledge (TPK)	○ I noted two different outcomes regarding the teaching methods used by teacher six, during and after using his laptop and the projector. Firstly, in a lesson during the first week, the teacher tried to use one of his ideas when using these tools. This included turning the electronic copy book from his laptop through the projector to the whiteboard. As a result, I noted that using these tools saved class time, affording the students more time to practise and the teacher to offer more examples. This led in greater retention of the information and an increase in the students' self confidence. However, when he returned to traditional teaching methods, I noted that in the initial 15–20 minutes of the class lesson, the teacher was always busy writing the tasks on the board. After that, he started to explain the task to them, and the in last 10 minutes he asked those students to transfer the answer from the board to their book; hence, the teacher wastes the class time writing on the board, which reflected negatively on the students' learning as it did not allow them time to practise the lesson more, to be easy to remember it and make them feel confident in terms of solving the task when they find it in upcoming lessons. ❖ From the above example, I can see how teaching and learning can change when he used technology, and this appeared during and after using his laptop and the projector.
Pedagogical Content Knowledge (PCK)	○ Teacher two preferred to move with his students from year one to year six. Because he believed that the first six years of a student life in school are a particularly sensitive period in learning and teaching mathematics. Therefore, when he is teaching these students from the first stage of education to the sixth stage, it will give him the opportunity for early intervention using the interactive whiteboard to avoid the

	persistence of negative results in the coming years. He added: *I will link the effect of early intervention with how IWB can help learners to learn mathematics, through this example. Some of my students faced mathematics anxiety when they were at year one that can impaired their development in math. I asked those students individual the reasons behind their anxiety, which appeared to me that five of them were punished by their parents for failing to master a mathematical concept or being embarrassed in front of a sibling when failing to correctly complete a mathematics problem. And other five mentioned that before they begun the school, their family warning them of mathematics in terms of the difficulty and need to give more effort in order to succeed, this led to increased concern of mathematics and resulted to failure in mathematics.* By linking the effect of early intervention with how IWB can help students to learn mathematics. He added: *The importance of early intervention with those students who have difficulty learning mathematics with the involvement of technology in this intervention, will benefit the students by reducing and eliminating the adverse results for students who experience mathematical difficulties, because this tool will make this subject more easy and entertaining*. o Also, in teacher three who believed that in today's world students use technology outside of the school environment for entertainment; therefore, using these technologies inside the school would engage students' interest in learning mathematics, which, in turn, would facilitate their ability to receive more information. I mentioned my opinion on this point on page 220. ❖ I can find from the examples above that teachers two and three know how to make mathematics easier to learn, what the misconceptions are that these students often bring with them about mathematics in the classroom, and how they try to overcome them.
Technological Pedagogical Content Knowledge (TPCK)	o Teacher three used The Number Race software through the IWB to help them overcome these difficulties. Generally, in the first week, he followed the book contents, which was the second chapter focusing on addition and subtraction. He planned to review the role of addition and subtraction with zero for about two weeks before starting the chapter, to link it to the difficulties they had encountered regarding multiplication. In the third and fourth weeks, he moved to the second chapter, and in the final two weeks, to the third chapter, which focused on multiplication concepts. It is clear that he had a strong desire to utilise every possibility offered by technology, and this appeared in his teaching

	methods. In the first four weeks, he used The Number Race software through the IWB to simplify and clarify addition and subtraction practice and representation. During these weeks, he also used the camera to record his students while using the program. In the final two weeks, he used a PowerPoint presentation to link what the students had learned in the first four weeks, by linking previous recordings through the camera to multiplication concepts. ❖ I can find from an example above that teacher three created an interaction between CK, PK and TK when he used the camera, the PowerPoint presentation and Number Race software through the IWB to assist his students who had difficulties in the concept of multiplication.

Table 6.2: Discussion of TPCK

It is interesting to mention the theoretical framework that has been selected for conducting this research, which included the Concern Based Adoption Model (CBAM) (Hall & Loucks, 1978; Sashkin & Egermeier, 1993) and the Technological Pedagogical Content Knowledge (TPCK) framework (Shulman, 1986; Mishra & Koehler, 2006); neither of these is sufficient to explain the use and non-use of technology. Although these models were helpful they were not enough to look at the whole picture of how to achieve better use of technology. In this study, the TPCK model helped me think about content and the match between pedagogical content, but does not help me on teacher beliefs, concerns and motivations. In addition, the CBAM model helped me to identify teacher concerns but not school problems such as if a teacher does not have any technology, so I was still stuck (Please see appeniex 20). This means in this study the researcher needed to take account of school level concerns and teacher level concerns and then use the TPCK framework. In other words, if the researcher only sorted out school concerns and teacher concerns (beliefs), then we can move to the TPCK model. This gives a really important explanation of why TPCK is only useful if you have other things sorted. Therefore, this model will be great if I work with a school that already has technology and support by the head teacher, such as school A, but not with school B which does not have technology. The following figure below illustrates when we can use CBAM and TPCK frameworks.

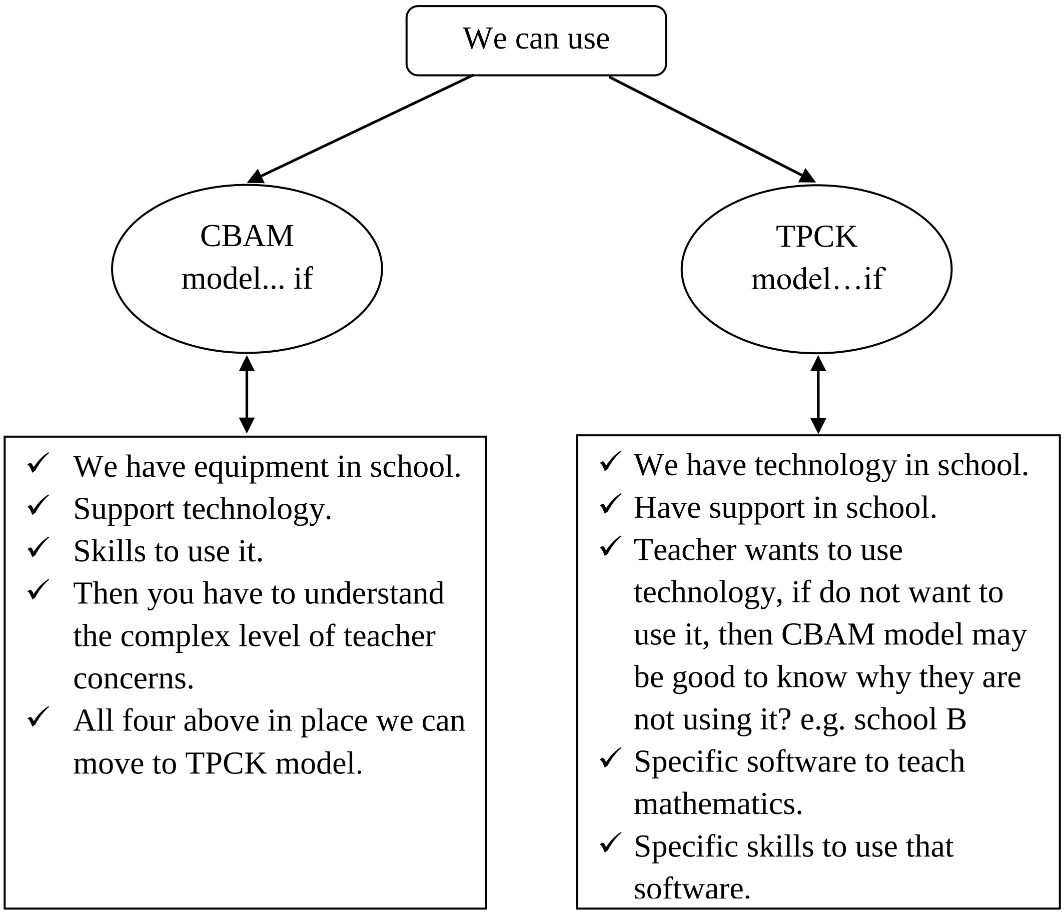


Figure (6.1): When we can use CBAM and TPCK frameworks.

When we look at the figure above and the two school cases, we find that school B does not have technology, the head teacher does not support the teachers in terms of providing, integrating and using technology within the classroom, and finally teachers four and five do not have the skills to use it. This means I cannot address teachers' concerns because the technological support is still one of the main concerns. This also gave me an indication that in this case I cannot use the TPCK model, because there is no technology in this school. While in the case of school A, they have technology in school, the head teacher supports and encourages them to use it, and the teachers want to use it. This means the researcher can use the TPCK model with them to understand the needs of those three teachers for effective pedagogical practice in technology to help those students with mathematics difficulties. On the other hand, this model does not help me to know about teacher beliefs and concerns. Therefore, in this study the researcher needs to use both of these models, CBAM and TPCK, and also look at school problems. In addition, it becomes clear in this study that there is a hierarchy in models; school comes first and I need to understand teachers' concerns and then move to a TPCK framework (see Figure 6.2)

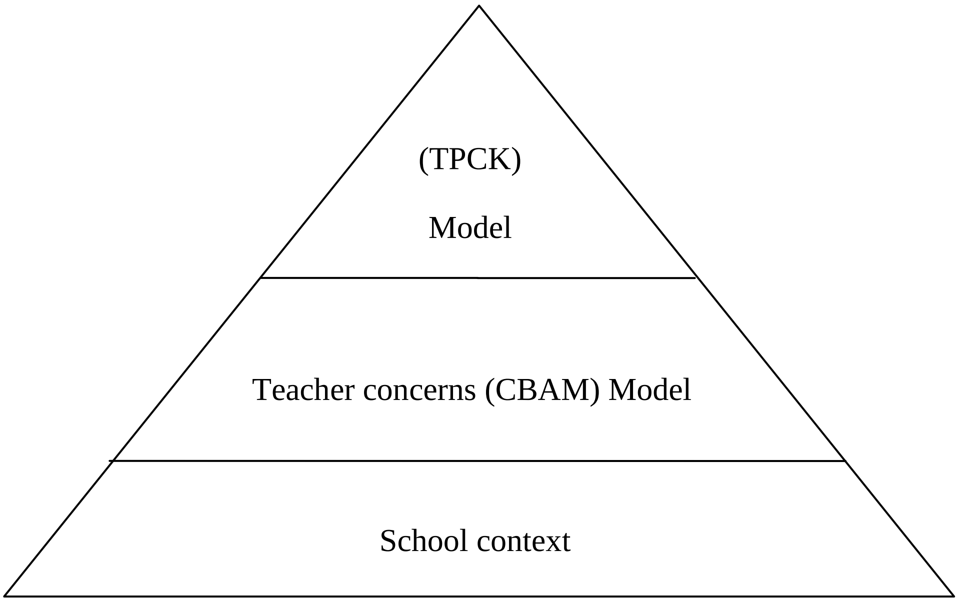


Figure (6.2): The hierarchy of the models

6.5 Summary of results

The study aims to help improve the quality of teaching mathematics in these two schools in the Kingdom of Saudi Arabia by investigating the obstacles to the use of technology in teaching mathematics.

These results that emerged from each case study were compared with each other through the responses to the interview questions, the researcher's observations and the literature across the four categories (see Table 6.3). This included teaching approaches, the effect of technology on students who have mathematics difficulties, the challenges faced with the use of technology, and mathematics difficulties.

Category	**study**	**What literature found**	**Research results**	**Consistent with**
Teaching approaches	1- Gutnik et al.(2011), Rideout, 2011), and Natalie (2011).	1- New approaches. 2- Traditional approaches.	1- New approaches. 2- Traditional approaches.	Gutnik et al.(2011), Rideout, 2011), and Natalie (2011).
The effect of	1- Torff & Tirotta	1- Student motivation.	1- Student motivation.	Torff & Tirotta

technology on students	(2010). 2- Mobasheri (2013). 3- Alabdulaziz (2013). 4- Gladkova (2013).	2- Save teacher time. 3- Boost students' confidence. 4- improve imagination skills.	2. Save teacher time 3- Boost students' confidence. 4- improve imagination skills.	(2010). Mobasheri (2013). Alabdulaziz (2013). Gladkova (2013).
The challenges faced with the use of technology	1- Jessica (2015), and Akkaya (2016). 2- Hsu (2016), and Alghamdi (2016). 3- Kafyulilo et al. (2016), and Mutohar, (2012).	1- The lack of teacher training. 2- The lack of technical support. 3- Head teacher's attitudes.	1- The lack of teacher training. 2- The lack of technical support. 3- Head teacher's attitudes.	Jessica (2015), Akkaya (2016), Hsu (2016), and Alghamdi (2016).
Mathematics difficulties	1- Sadi (2007). 2- Sadi (2007), and Barr (1984).	1- failed to understand that any number multiplied by zero equals zero. 2- Difficulty on borrowing from zero in subtraction.	Same results.	Sadi (2007), and Barr (1984).

Table 6.3: Summary of the research results

6.6 Overall case study methodology

In this section I will discuss the strengths and the weaknesses of the case study approach, starting with the strengths, where this method allowed me to use different strategies from interviews to observations, which led me to get an in-depth understanding of these two contrasting schools through the investigation of the barriers that teachers face when using technology in their classrooms in the Kingdom of Saudi Arabia, and why some overcame obstacles and why others did not. This is apparently consistent with Yin (2009), who suggested that case study would allow the researcher to provide in-depth understanding, as well as enable a particular phenomenon to be examined within a certain environment, where a particular aspect is concentrated on

(Yin, 2009). As suggested by Creswell (2007), with the utilisation of this technique the researcher is able to examine a bounded system, which is done through in-depth data collection from a variety of sources. As described by Yin (1994) the technique of case study is appropriate to handle the two questions of how' and 'why', which not have not tackled enough by other research strategies. Furthermore, this method gave me access to not only the numerical information concerning the use of technology, but also the reasons for their use or disuse of technology, and how the technology is used in classrooms. As indicated by Gummesson (1988), a key advantage of the utilisation of a case study in research work is related to the all-encompassing nature with which the process is encircled. Typically, case studies involve this kind of all-encompassing information which is vital to assisting the investigation and depiction of the information in a real-world situation, as well as to aiding the illustration of the intricate nature around real-world scenarios, which cannot be otherwise achieved in the event of a different technique being employed (Velez, 2008).

On the other hand, Yin (1984) discusses three types of arguments against case study research. First, case studies are often accused of lack of rigour. Yin (1984) notes that "*too many times, the case study investigator has been sloppy, and has allowed equivocal evidence or biased views to influence the direction of the findings and conclusions*" (p. 21). In this research, for example, to minimise bias, each teacher interviewed was initially assigned an identical task. During the interview, care was taken to avoid leading the teachers towards any particular viewpoint, so responses to questions were accepted as they were given and probing questions were asked simply to ascertain the reasons for what the teacher thought. Additionally, in some cases, teachers were asked to comment on the transcripts to ensure that the meaning constructed by me was the same as that constructed by the teachers. Moreover, the researcher collected the interview data by interacting face-to-face with the participants and physically observing their actions in their classrooms. As the research was with mathematics teachers, the researcher endeavored to create mutual understanding and a healthy relationship in my daily interactions with the participants. As the researcher integrated with the participants, the power relationship was flattened, and the "researcher" became one of the participants.

The second weakness of case studies is that they provide very little basis for scientific generalisation since they use a small number of subjects, some conducted with only one subject. A common criticism of case study method is its dependency on a single case exploration making it difficult to reach a generalising conclusion (Tellis, 1997b). Yin (1993) considered case methodology ‘microscopic’ because of the limited sampling cases. To Hamel et al. (1993) and Yin (1994), however, parameter establishment and objective setting of the research are far more important in case study method than a big sample size. I acknowledge that the findings of my study may not be general to all settings because teachers in other areas and countries are likely to have very different experiences and hence their reasoning would differ. However, the goal of most qualitative studies is not to generalize but rather to provide a rich, contextualized understanding of some aspects of human experience through the intensive study of particular cases. I acknowledge that the findings of my study may not be general to all settings because teachers in other areas and countries are likely to have very different experiences and hence their reasoning would differ. We know that the goal of most qualitative studies is not to generalize but rather to provide a rich, contextualized understanding of some aspects of human experience through the intensive study of particular cases. However, the researcher believes that this city was a good place to conduct this study, because it has a big population which is drawn from different parts of the Kingdom of Saudi Arabia. This also was seen in the six mathematics teachers who participated in this study, who came from different cities of Saudi Arabia. Third, case studies are often labelled as being too long, difficult to conduct and producing a massive amount of documentation (Yin, 1984). I think, in case study, I needed this rich information to get an in-depth case study of these two contrasting schools, otherwise it would have been difficult to reach the research objectives which led me to answer my research questions.

Similarities and differences between the current study and previous studies

This study used qualitative case study with a combination of observations and interviews to improve the quality of teaching mathematics in these two schools in Saudi Arabia through investigating and understanding the barriers that teachers face when using technology in their classroom in primary schools, and particularly why some overcame obstacles and why others did not. Little studies in the literature review used the same method of this study and other studies used other methods, such as questionnaires and surveys; however, all of them did not get in-depth information about the obstacles that teachers faced when using technology and why some overcame obstacles and why others did not. Also, there is another difference between the current study and previous studies which will appear in the following examples. A study by Alabdulaziz (2013), which used semi-structured interviews and observations to collect his data, interviewing and observing four mathematics teachers and 12 students at elementary school, sought to build a picture on the effect of using technology with pupils who have mathematics difficulties from the teacher's point of view. Although the study has confirmed the positive effects of technology on students with mathematics difficulties, one of the participating teachers did not use it with his students for three reasons. First, the teacher simply needed to be trained to use the technology. Furthermore, there is no reward system in place for innovative teaching. Additionally, he thought that the traditional blackboard would make complicated problems more solvable. But now he has changed his mind about the value of technology and began using it. Therefore, the researcher recommended that further research work could focus on the obstacles of using technology in primary schools to help students with mathematics difficulties in Saudi Arabia. As a result, the current research extended the recommendations of this study.

In addition, Wachira and Keengwe (2011) investigated urban school teachers' perspectives on barriers that hinder technology use in mathematics classrooms. This study employed a varied methodology which coordinated qualitative and quantitative elements. A total of 20 teachers participated, 15 females and 5 males. Certain barriers to the improving and increasing the use of this technology were discovered by the study; examples of these being the time factor and the restricted number of technology tools, additional the scarcity of teachers trained for this technology, and the lack of a reward system for imaginative teaching. I can find that there are three differences, compared with this study, including the difference in methodology, sample and the results of the study. Furthermore, in a study by Sugar et al. (2004), beliefs held by educators about the decision to embrace technology were discussed. The qualitative and quantitative data gathered were sourced from educators from four schools in the south-eastern part of the USA. Based on overall findings, the decision to embrace technology was impacted by the individual stances of the educators on the incorporation of technology. I can find that this study focuses only on educators' beliefs about the decision to embrace technology, they used a mixed approach which is qualitative and quantitative, the area of this study not in the Arab world.

Other studies such as those by Newhouse (1998) and Niederhauser and Stoddart (1994) included the conducting of surveys on teachers to investigate their beliefs about the perceived value of computers for student learning. Also, I can find that they focus only on teachers' attitudes regarding computers, and used a different approach, compared with this study. I will discuss this more in the next section which is about contribution to knowledge.

6.7 The contribution

Despite the potential positive effects of using technology with students who have difficulties in mathematics in the Kingdom of Saudi Arabia and the great efforts made by the Saudi Government to improve the education system of the nation, which has included a continuous rise in the educational budget, there still remain some obstacles for some teachers when using technology, and while some of these teachers overcome these barriers, others do not succeed in this the challenge. The literature chapter in this study provides the context for a summary of mathematics difficulties, the effect of technology on students who have these difficulties, and barriers to using technology for teaching and learning mathematics. The contribution of this research is to improve education outcomes in Saudi Arabia through investigating and understanding the barriers that teachers face when using technology in their classroom in primary schools, and particularly why some overcame obstacles and why others did not. As a result, these findings will assist the educational supervisors for these two schools in reaching a clarification regarding the hurdles that face teachers who teach mathematics and help them overcome those problems. That reflected positively on the teaching and the learning of students with difficulties.

There has been little research conducted on the barriers to the use of technology in teaching and learning in Saudi Arabia. However, they did not answer the following two questions: Why are some mathematics teachers overcoming the obstacles they face when using technology to benefit their students? Why do some mathematics teachers not succeed in overcoming the obstacles that prevent them from using technology to benefit their students? This was therefore a specific area in which this thesis sought to make a contribution to our understanding about these reasons, which lead to lower the difference between the amount of money being expended on the education of pupils and the negative results in mathematics students.

The effects of the application of technology in primary schools to students who have difficulty understanding mathematics have been studied by this author during the pursuit of a master's degree. It was discovered that although the effects of technology use in teaching of mathematics were largely positive, there are some obstacles that teachers face while using technology. Therefore, the decision was made to investigate more on the obstacles that are faced by mathematics teachers and particularly why some overcame obstacles and why others did not. As a result, the study will contribute to bridging a gap in the literature through investigating and understanding these reasons with teachers in the kingdom of Saudi Arabia, because I did not find previous studies in this area in the Arab world.

The fourth difference is in the methodology used to collect the data; this study adopts the qualitative research method to address the research questions. In order to collect the qualitative data, the research method used semi-structured interviews and observations, which have not previously been used in Saudi Arabia by researchers in this context.

Fifthly, it is interesting to mention the theoretical framework that has been selected for conducting this research, which included the Concern Based Adoption Model (CBAM) (Hall & Loucks, 1978; Sashkin & Egermeier, 1993) and the Technological Pedagogical Content Knowledge (TPCK) framework (Shulman, 1986; Mishra & Koehler, 2006); neither of these is sufficient to explain the use and non-use of technology. Although these models were helpful they were not enough to look at the whole picture of how to achieve better use of technology. In this study, the TPCK model helped me think about content and the match between pedagogical content, but does not help me on teacher beliefs, concerns and motivations. In addition, the CBAM model helped me to identify teacher concerns but not school problems such as if a teacher does not have any technology, so I was still stuck. Therefore, each model separately is not enough on its own, as neither of them take account of school concerns. This means that the researcher needs to use both of these models, CBAM and TPCK, and also look at school problems. In addition, it becomes clear in this study that there is a hierarchy of models, school comes first and I need to understand teachers' concerns and then move to the TPCK framework.

Sixthly, it is interesting to mention that I can offer something that is very specific in my study. I can say that all the studies in the literature review confirm that, if we want to achieve teaching and learning with technology fully, these kinds of things have to be in place: head teacher support, training for teachers to use technology, technical support, and positive attitude towards technology. All these were important and my study confirms this, and these all need to be in place (head teacher support, training for teachers to use technology, technical support, and positive attitude towards technology), but the researchers stop at these barriers, which did not include the subject knowledge, this means we have to make a stronger mathematics connection. In other words, teachers have to use specific software to teach multiplication and subtraction, for example, they need the software that leads them to represent multiplication and subtraction and they need to know how to teach multiplication and subtraction. We need good software and good knowledge, because even if we give teachers good software and they still are not able to use it, because their mathematics knowledge is not sufficient, this will lead them to not using it. All of these need to be in place for a successful use of technology.

Even specialists when devising the Tatweer project in Saudi Arabia, started to overcome these barriers quite well in most Tatweer schools and teachers, but they did not cover the subject knowledge development, and some teachers may be doing this by themselves. This is because the project was designed to support general teaching with technology without thought of subject knowledge. In other words, the project was not designed to support excellent mathematics teachers with technology. I think that, if we want to support teachers to develop their mathematics subject knowledge, we do not necessarily have to do a separate course on mathematics subject knowledge development, we can provide one training course about the ways of using technology to teach mathematics well, and at the same time, we will teach the teachers the mathematics.

6.8 Reflexivity

As suggested by Hammersley (1993), the results of research work differ depending on the individual undertaking it. They might be slight, but differences would still be there. Although they might not highlight a different story, differences could be related to matters, such as ‘emphasis and orientation’. Because of the researchers’ role in the research work they are conducting, there would always be differences. Therefore, the importance of reflexivity is highlighted in all the stages of this thesis. Chapter one included my illustration of personal reason as to why I am embarking upon this research work, as well as how based on this the goals and questions of the research work are established. In Chapter four, which covers the methodology, I initially provided a part on my role as the researcher. In Chapter five, which covers the data analysis, I reflected the challenges I faced during the data collection, as well as the impact of these challenges on the research work. Lastly, this chapter (section 6.8) includes my review of the journey of research, in addition to its influence on me.

To help understand how I may have influenced the research work, it is perhaps beneficial for me to select one of the reasons, as to why I have decided to conduct this research work, to begin with it. Indeed, the effects of the application of technology in primary schools to students who have difficulty understanding mathematics have been studied by me during the pursuit of a master's degree. It was discovered that although the effects of technology use in teaching of mathematics were largely positive, there are some obstacles that teachers face while using technology. Therefore, the decision was made to investigate and understand the barriers that teachers face when using technology in their classroom in primary schools, and particularly why some overcame obstacles and why others did not. Thus, there are two key questions: Why are some mathematics teachers overcoming the obstacles they face when using technology to benefit their students? Why do some mathematics teachers not succeed in overcoming the obstacles that prevent them from using technology to benefit their students? Therefore, I can say that my degree study, on mathematics education, has enabled me to develop an understanding about the procedure of research. I was aware of the quantitative research ideas; however, with a qualitative research approach, I have been able to discern how deep the experience that could be examined through this technique is.

With regard to the sampling procedures, I avoided any impacts that might affect choosing my data. This appeared when I sent a letter to a number of schools to request their participation. The letter included an introductory letter and consent form that was requested be sent back to me to indicate willingness to participate. I chose the schools that returned the letter to me first to be part of my research, taking into consideration that one of them had technology and another did not. Fortunately, I found all three mathematics teachers in school A have different experiences with using technology, compared with the school B. Furthermore, I chose male students in my study is because students in the Kingdom of Saudi Arabia in all levels at schools must be in single-sex classes and be taught by a teacher of the same gender. Therefore, a male researcher will only have access to boys-only schools.

Moving to the ethical issues and data that required the application of reflexivity, as I mentioned in the methodology chapter, some of those six mathematics teachers were reluctant to talk about the main reasons why they were not using technology with their students. But my relationship with the teachers over the long periods of observation and in-depth interviews made me confident about the accuracy of data. Thus, I took advantage of this relationship, but this needed reflexivity to be applied. Accordingly, I adopted a number of measures for ensuring my research integrity; I offered an explication of what I was doing and why I was researching this subject. I also elucidated accurately what I aimed to do in relation to the interviews and observations taken in the classroom. On every single occasion, I unequivocally sought the approval of the participants to collect information from the interviews with them and from the classroom observations. Further, I ensured that each participant's identity alongside their personal information is kept in secrecy, thus during the translation process their names would be protected. According to Creswell (2003), the researcher has the responsibility of ensuring that participants' rights are taken into consideration.

With regard to the analysis of my data, one other technique through which to engage in reflexivity was the setting up of meetings with my supervisors who regularly discussed the analytical examination of data. These research supervisors come from a contextual background, which differs from that of the researcher; their assistance and support throughout the analysis process was beneficial, given that they were able to raise issues and ask questions. Interested in an enthusiastic about the topic of the research, they all successful engaged in several thorough and enthusiastic debates and instilled me with an incentive and various aspects to think about. Indeed, I was fortunate enough to be under the care of these supervisors throughout the research journey.

6.9 Limitations of the study

Although this project was carefully prepared, it still faced a number of limitations, which did not have a negative effect on the findings. These can be summarised as follows:

1- This study focused only on government primary schools in the east of Saudi Arabia. Consequently, it may not be possible to generalise the results countrywide. Maxwell (2005) argues that, "indeed, the value of a qualitative study may depend on its lack of generalisability in the sense of being representative of a larger population" (p.115). However, the researcher believes that this city was a good place to conduct this study, because it has a big population which is drawn from different parts of the Kingdom of Saudi Arabia. This was seen in the six mathematics teachers who participated in this study, who came from the middle of the country, the *western* part of the KSA, and also from the north-western part of the KSA, and the south-*west* of the Kingdom.
2- All of the participants were male, which is because the official religion of Saudi Arabia is Islam, which states that all students except those in their first three years in education must be in single sex classes and be taught by a teacher of the same gender. As a result, access to schools with a female complement for a male researcher is extremely limited.
3- The study sample focused on teachers only, because they are the first people who play a key role in educating students in the classroom. However, the study could have included students and head teachers if there were no restrictions of time.

6.10 Recommendations

1- Teachers in these two schools can take advantage of the valuable ideas that were presented by the participants during their use of the technology in this study, and apply these ideas with their students in the classroom.
2- With regard to training, I can find that all six teachers agreed that the head teacher is the only person who can initiate the necessary teacher training. The three teachers in school A gave us an example of how their principal introduced the necessary training. Teacher one believed that this was achieved through stimulating the teachers; teacher two, by making teacher evaluations, including regular attendance on training courses; and teacher three, by reducing or removing the extra workload on the teachers so they could attend training. Therefore, the researcher recommends school principals in two schools to benefit from these examples and apply them with their teachers at their schools, to improve essential teacher training.

3- Moving to the technical support obstacle, all three teachers in school A agreed that their head teacher had a positive tangible impact on overcoming the obstacle of technical reforms. This appeared when I extracted from the interviews that he had allocated part of the budget received from the Ministry of Education to provide a technician to support his teachers in cases of technological malfunctions. The first and second teachers added that their head teacher has mastered the disposition of the use the budget made him unique, as he ensured they did not hear this term at all "it is not available in the school''. Therefore, the researcher further recommends head teacher in school B to allocate budget resources to encourage teachers to continue the use of the technology, as this will lead to enhancement of both teaching and learning.

4- With regard to how the negative attitudes of teachers towards the use of technology can be overcome, I can learn from the three teachers in school A; teachers two and three agreed that we should provide appropriate training that focuses on hands-on practice rather than imparting verbal information. Furthermore, teacher one added that he would like to invite those teachers with a negative attitude towards technology to see for themselves the positive impact of technology through attending a lesson with another teacher who uses technology. The researcher recommends trainers to make sure that, when they train those teachers on technology, they focus on practical training. This is preferable to imparting verbal information, which often does not benefit training in the use of technology and may make teachers feel that attending such training is not useful.

5- All three teachers tried to discuss the importance of the use of technology in mathematics, particularly with students who have difficulties with mathematics. Therefore, they think that if the teachers discuss their need of technology and show the advantages of using it, this may help them to change head teachers' attitudes. Therefore, the educational supervisors for these two schools should have a continuous follow-up in terms of knowing the problems that the teachers have with the technology to enable them to take full advantage of technology in teaching students.

6- The researcher also recommends that the head teacher in school B should have a positive attitude towards technology, because I noticed that the head teachers' attitude affected the challenges their teachers faced. In school A, he succeeded in encouraging and supporting his teachers in overcoming the difficulties they faced when using IWB, which led us to notice that the teachers did not face any challenges or difficulties during the use of IWB. That reflected positively on the teaching and the learning of students with difficulties. On the other hand, the head master in school B did not help his teachers overcome challenges to achieve their desires to take advantage of the positives of the use of IWB, which led to a lot of challenges when they taught their students, reflecting negatively on the teaching and learning of students with difficulties.

7- We need to develop subject-specific software in these two schools, particularly in mathematics, and this is less of an issue when teaching the Arabic language, for example, because we can use general software, such as words processers or PowerPoint for teaching Arabic, but for teaching mathematics, we need a very specific representation for a specific part of mathematics.

8- Today's students love technology and they use it outside of the school environment for entertainment; therefore, teachers should using these technologies inside the school to engage students' interest in learning mathematics (I add my view on this point on page 220).

9- The groundwork for future learning and future skills are laid by primary education because the skills and values that are instilled there are absolutely foundational. In addition, primary education serves as the base on which students build upon during further schooling. Therefore, teachers in both schools should help those students to overcome any misconceptions or difficulties they face with mathematics, to make sure that students do not continue struggle with mathematics in future education.

6.11 Suggestions for further research

The researcher recommends that additional research be conducted in several areas:

1- This study could be replicated and extended to include middle and high schools with a larger sample size.

2- Further studies need to be conducted to investigate the difficulties that face mathematics teachers when explaining the lesson through the new development of the mathematics curriculum without technology. This is because I noticed that all three teachers in school A mentioned that since the recent developments in the mathematics curriculum were introduced by the Ministry of Education, technology has become an integral part of the curriculum and has facilitated covering all the key mathematical concepts in the syllabus through IWB. This was confirmed by the responses of teacher two and teacher three who both agreed that before the development of mathematics curriculum, they had found difficulty in covering all the mathematics topics.

3- Further studies also need to be conducted to investigate the skills provided by universities and colleges for their students to allow them to benefit from the technology through their teaching in the schools in the future.

4- Part of this study focused only on the effect of technology on students who have difficulties in subtraction and multiplication, but another study could focus on other areas of mathematics, such as division and fractions.

5- More research needs to be conducted to determine the role of students in influencing the attitudes of school principals toward technology.

6- More research needs to be conducted to determine the role of students in influencing the attitudes of teachers toward technology. Because when we look back to the previous chapter we find that teacher three believed that in today's world students use technology outside of the school environment for entertainment; therefore, using these technologies inside the school would engage students' interest in learning mathematics, which, in turn, would lead them to be more willing and able to receive more information.

7- There is also an urgent need to see the views of head teachers in regard to the effect of technology in teaching and learning, and what the main obstacles are that are faced by his teachers through the use of technology.

6.12 Conclusion

Despite the potential positive effects of using interactive whiteboards (IWB) with students who have difficulties in mathematics in the Kingdom of Saudi Arabia and the great efforts made by the Saudi Government to improve the education system of the nation, which has included a continuous rise in the educational budget, there still remain some obstacles for some teachers when using IWB, and while some of these teachers overcome these barriers, others do not succeed in this the challenge. This study investigated the barriers that teachers face when using technology in their classroom in primary schools, and why some overcame obstacles while others did not. Semi-structured interviews and observations were used for the purpose of this research, which were undertaken with three mathematics teachers from school A which used technology, and the other three from school B, which did not use technology. I found that the major obstacle teachers face when using IWB included aspects of the teachers' negative attitudes and beliefs about teaching mathematics using technology, the lack of training in using technology, and the lack of technical support. The head teacher's attitude was also an important influence on managing the challenges teachers faced, which affected teachers' decisions to use or not use IWB in school.

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Appendix 1

Ethical Approval Record

Dear Mansour,

I am writing to inform you that your application for the research project “The obstacles to using technologies in primary schools to help students with mathematics difficulties in the Kingdom of Saudi Arabia” has been approved.

Regards

Nicola

Nicola Apperley

Research Grant Coordinator

Research Office, Room ED230

School of Education, Leazes Road, Durham University, Durham, DH1 1TA

Tel : 48397 or 0191 3348397 0191 3348397

nicola.apperley@durham.ac.uk or ed.finres@durham.ac.uk

** Please note my working hours are Mon/Tues 9.30am to 5pm, Weds/Thurs/Fri 8.30am to 2.30pm **

Appendix 2

Cover Letter for Participant Information Sheet

Dear mathematics teacher,

The obstacles to using technologies in primary schools to help students with mathematics difficulties in the Kingdom of Saudi Arabia

I am writing to you about the research I am conducting as part of my PhD at the University of Durham.

I am interested in investigating the obstacles to using technology in primary schools to help students with mathematics difficulties in the Kingdom of Saudi Arabia. Therefore, I chose interviewing and observation as techniques for the purpose of this research and because data collected through interviews and observations can be compared. In addition, observations are crucial to see the effect of technology on the students' mathematical learning. However, observation may not be enough. As I want to investigate the barriers that teachers face when use technology, and why they overcame obstacles and why not.

Six mathematics teachers with various academic backgrounds will participate in this study; some of these teachers use technology with their students and some of them do not use it with their students.

I will interview each one of these six teachers and ask them general questions about the use of technology (Part 1), then I will observe each one in their classrooms and, finally, I will again interview each teacher individually asking them specific questions to address my research questions (Part 2). In my thesis all of the teachers who participates will be anonymous.

It would be very helpful if you could take part in my research. Please read the information sheet attached to this letter and, if you are willing to take part in this study, please sign and return the consent form enclosed.

If you have any further questions about the research, please contact me on: m.alabdulaziz@hotmail.com . If you have any concerns about the research please contact my supervisor: Steve Higgins.

Yours sincerely,

Mansour Saleh Alabdulaziz

Durham University- United Kingdom

Appendix 3

Participant Information Sheet

The obstacles to using technologies in primary schools to help students with mathematics difficulties in the Kingdom of Saudi Arabia.

Researcher: Mansour Saleh Alabdulaziz.

Supervisor: Steve Higgins.

I would like to invite you to take part in my research and I need your signed consent if you agree to participate. Before you decide, you need to know why I am doing this research and what it will involve. Please take time to read this information carefully to help you decide whether or not to take part. Please contact me if there is anything that is not clear or if you would like more information. Thank you for reading this.

What is this study about?

The obstacles to using technologies in primary schools to help students with mathematics difficulties in the Kingdom of Saudi Arabia.

How will you be involved?

Six mathematics teachers with various academic backgrounds will participate in this study; some of these teachers use technology with their students and some of them do not use it with their students.

I will interview each one of these six teachers and ask them general questions about the use of technology (Part 1), then I will observe each one in their classrooms and, finally, I will again interview each teacher individually asking them specific questions to address my research questions (Part 2).

Who will have the access to the research information (data)?

Data management will follow the 1988 Data Protection Act. I will not keep information about you that could identify you to someone else. All the names of the individuals taking part in the research and the school(s) will be anonymised to preserve confidentiality. The data will be stored safely and will be destroyed when my project is completed.

The data will only be used for my work and will only be seen by myself, my supervisor, and those who mark my work.

Who has reviewed the study?

The research study has been approved under the regulations of the University of Durham School of Education and Lifelong Learning Research Ethics Committee.

Who do I speak to if problems arise?

If there is a problem please let me know. You can contact me via the University at the following address:

Mansour Saleh Alabdulaziz.

School of Education.

Durham University

Durham DH1 1TA

m.s.alabdulaziz@durham.ac.uk

OK, I want to take part – what do I do next?

You need to fill in one copy of the consent form.

Can you change your mind?

Yes. You have the right to withdraw from the research at any time.

Thank you very much for your time.

Appendix 4

Consent Form For Research Project

The obstacles to using technologies in primary schools to help students with mathematics difficulties in the Kingdom of Saudi Arabia

I have read the information about the study.

Please tick the relevant box

The purpose and nature of the study has been explained to me in writing ☐

I give permission for my interview to be recorded and transcribed. ☐

I understand that I can withdraw from the study, without penalty, at any time, either before it starts or while I am participating. ☐

I understand that anonymity will be ensured in the analysis and write-up of the research. ☐

I understand that anonymous extracts from my interview may be quoted in the thesis and any subsequent publications ☐

Signed...................................………...........................

Date...

Name ....……..............

Appendix 5

Teachers interview questions (Part 1) (English)

1- Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology? (Then I will move to questions 6, 7 and 8).

2- What are the types of technology you use with those students?

3- Does the technology help you cover the key mathematics concepts in the syllabus?

4- Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?

5- Have you learnt anything new by using technology in your class?

6- What are the main reasons behind the decision of the mathematics teacher to not use technology to help students with mathematics difficulties? (Teachers themselves, school, government).

7- What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of:

- Training teachers to use technology?

- Technical support?

- Teacher attitudes and beliefs about teaching mathematics with technology?

8- Do you need any further support to use technology, and if so, what support do you need?

Appendix 6

Teachers interview questions (Part 1) (Arabic)

أسئلة عامة (الجزء الأول)

1- هل تستخدم التكنولوجيا في الحصة الدراسية لمساعدة الطلاب الذين يعانون من صعوبات الرياضيات؟ إذا كان الأمر كذلك، لماذا قررتم استخدام التكنولوجيا؟ إذا لم يكن كذلك، لماذا لا تستخدم التكنولوجيا؟ (ثم انني سوف انتقل الى السؤال السادس, السابع والثامن).

2- ما هي أنواع التكنولوجيا التي تستخدمها مع هؤلاء الطلاب؟

3- هل التكنولوجيا تساعدك في تغطية مفاهيم الرياضيات الأساسية في المنهج؟

4- هل تعتقد أن التكنولوجيا تساعد الطلاب الذين يعانون من صعوبات تعلم الرياضيات ، وإذا كان الأمر كذلك، كيف يمكن أن تساعد المتعلمين على التعلم؟

5- هل تعلمت أي شيء جديد لإستخدام التكنولوجيا في صفك؟

6- ما هي الأسباب الرئيسية وراء قرارك في عدم استخدامك للتكنولوجيا لمساعدة الطلاب الذين يعانون من صعوبات الرياضيات؟ (المعلم، المدرسة، الحكومة).

7- ماذا تعتقد العقبة الرئيسية التي تواجه المعلمين عند استخدام التكنولوجيا مع هؤلاء الطلاب الذين لديهم صعوبات الرياضيات من حيث:
- تدريب المعلمين على استخدام التكنولوجيا؟
- دعم فني؟
- مواقف ومعتقدات المعلمين حول تدريس الرياضيات مع التكنولوجيا؟

8- هل تحتاج إلى أي دعم إضافي لاستخدام التكنولوجيا، وإذا كان الأمر كذلك، ما هو الدعم الذي تحتاجه؟

Appendix 7

Teachers interview questions (Part 2) (English)

1- Why did you decide to use/not use technology for this lesson with students who have mathematics difficulties?

2- Is technology used to increase basic skills, to make the understanding of complex mathematical operations easier or as a resource to entertain students?

3- How often do you use technology when teaching students with mathematics difficulties?

4- Where do you usually get your ideas from for using technology? (Magazines, colleagues, workshops, technology coordinator, Internet, etc.)

5- Did your college education include any learning activities on how to use technology for teaching those students?
   If yes, please describe?
   If not, how did you overcome the problem of training?

6- If offered, how likely would you be to participate in technology training either during or after school time?

7- If no, what factors may have led you to not attend training sessions?

8- What is needed to make the necessary teacher training work?

9- If you wanted a technical support in your class but it is not available in the school right now, how would you overcome this problem?

10- How can we overcome the negative attitude of teachers towards the use of technology?

Appendix 8

Teachers interview questions (Part 2) (Arabic)

أسئلة خاصة (الجزء الثاني)

1- لماذا قررتم استخدام / عدم استخدام التكنولوجيا لهذا الدرس مع الطلاب الذين لديهم صعوبات الرياضيات؟

2- هل التكنولوجيا المستخدمة لزيادة المهارات الأساسية، أو لجعل فهم العمليات الرياضية المعقدة أسهل أو للترفيه عن الطلاب؟

3- كم غالباً تستخدم التكنولوجيا عندتدريس طلاب صعوبات الرياضيات؟

4- من أين تستمد عادةً افكارك لإستخدام التكنولوجيا؟
(مجلات، الزملاء، ورش العمل، منسق التكنولوجيا، الإنترنت، الخ)

5- هل تعليمك الجامعي كان يتضمن أي أنشطة للتعلم على كيفية استخدام التكنولوجيا لتدريس هؤلاء الطلاب؟
إذا كانت الإجابة بنعم، أرجو الإيضاح؟
إذا لم يكن كذلك، كيف يمكن التغلب على مشكلة التدريب؟

6- إذا عرض عليك التدريب على استخدام التكنولوجيا أثناء أو بعد وقت الدوام، كيف سيكون إحتمالية مشاركتك في التدريب؟

7- إذا رفضت عرض التدريب، ما هي العوامل التي قادتك إلى عدم حضور الدورات التدريبية؟

8- كيف نجعل المعلمين يحرصون على حضور الدورات التدريبية؟

9- إذا أردت الدعم الفني في صفك ولكن لم يكن متوفرا في المدرسة حالياً، كيف تتغلب على هذه المشكلة؟

10- كيف يمكننا التغلب على موقف المعلمين السلبي إتجاه إستخدام التكنولوجيا؟

Appendix 9

Letter from my supervisor to Saudi Embassy in UK

Durham University

School ofEducation Leazes Road Durham
University DH1 1TA

9th June, 2014

Dear Sir/Madam,

Re: Mr Mansour Saleh Alabdulaziz

Mr. Mansour Saleh Alabdulaziz is a registered Ph.D. student at the School of Education, Durham University, working under my supervision, undertaking a study on “The obstacles to using technologies in primary schools to help students with mathematics difficulties in the Kingdom of Saudi Arabia”.

I am writing to inform you that Mansour is planning to undertake fieldwork trips for the purpose of data collection in his home country of Saudi Arabia between 25/09/2014 to 25/12/2014. This period is necessary so that schools will be able to accommodate his needs for data collection.

Please do not hesitate to contact me if you require further information.

S. E. Higgins

Professor S. E. Higgins
Supervisor Email: S. E. Higgins@durham.ac.uk
Direct Dial-in (+44/0) 191334 8324

Appendix 10

Letter from the researcher to the Ministry of Education

بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

إلى من يهمه الأمر / إدارة التخطيط والتطوير المحترم

السلام عليكم ورحمة الله وبركاته,,,

أنا أدرس حاليا للحصول على الدكتوراه في جامعة دورهام في المملكة المتحدة، وعنوان رسالتي هي " العقبات التي تحول دون استخدام التكنولوجيا في المدارس الابتدائية لمساعدة الطلاب الذين يعانون من صعوبات الرياضيات في المملكة العربية السعودية ".

وأود أن أجمع البيانات الخاصة بي كجزء من درجة الدكتوراه في المملكة العربية السعودية. وهذه الرحلة العلمية تستمر من 25-09-2014 إلى 25-12-2014. سوف أستخدم المقابلات والملاحظات لجمع البيانات، حيث أن المشاركون هم معلمي الرياضيات في بعض المدارس الابتدائية.

أقدر لكم موافقتكم على طلبي. إذا كنتم بحاجة إلى أي معلومات إضافية، لا تترددوا في الاتصال بي عن طريق البريد الإلكتروني:

m.alabdulaziz@hotmail.com

مع خالص التقدير

Appendix 11

Examples of the hand-written notes of the researcher's observations (Arabic)

	المعلم الاول	المعلم الثاني	المعلم الثالث
وصف الفصل الدراسي بشكل عام	١- تقضي معظم الحصص مع طلابه في مختبر الرياضيات ٢- جدران المختبر ملونه باللون الاخضر. ٣- يوجد سبورة ذكيه. ٤- تم ترتيب مقاعد الطلبة على شكل نصف دائرة. ٥- يوجد أجهزة كمبيوتر.	١- مساحة الفصل واسعة. ٢- سبورة ذكية مع ملحقاتها. ٣- يوجد ملصقات على الجدران لتحفيز الطلاب على التقدم. ٤- تم ترتيب مقاعد الطلاب في مجموعات حيث أن كل مجموعة يوجد بها خمسة طلاب.	١- لوحه رسوم عليها صورة كبيرة للشمس مع الوجه الضاحك مع عباره الرياضيات سهلة. ٢- سبورة ذكية مع ملحقاتها. ٣- يوجد لوحة كبيرة على الجدار الداخلي للفصل لإظهار أعمال وانجازات الطلاب. ٤- تم ترتيب مقاعد الطلبة على شكل نصف دائرة. ٥- يوجد أربع نوافذ مستطيلة
وصف البيئة الصفية	١- يتعامل المعلم مع الطلاب بشكل ودي. ٢- يشجع الطلاب على التفاعل والمشاركة بفعالية ٣- يبتسم دائماً عند الحديث مع الطلاب. ٤- يستخدم الايماءات الجسدية بشكل دائم. ٥- قلبه مفتوح لجميع الطلاب.	١- يتمتع المعلم بروح الدعابة. ٢- يحترمه جميع الطلاب. ٣- يعطي جميع الطلاب نفس القدر من الاحترام. ٤- إذا لاحظ المعلم أثناء الدرس أن بعض الطلاب لم يكونوا في جو الدرس يحاول التوقف عن الدرس لبعض الوقت، ومن ثم العوده إلى الدرس مره أخرى. ٥- تعبيرات وجهه وأسلوبه مع الطلاب تبين أنه مسرور جدا لتعليمهم.	١- علاقته ايجابية مع طلابه. ٢- يتعامل المعلم مع الطلاب بشكل ودي. ٣- يحترم ويساوي بين الطلاب من مختلف الثقافات والخلفيات. ٤- يحاول أن لا يثبط طلابه عند الإجابة على أي سؤال ليس له صله في موضوع الرياضيات. ٥- يساعد الطلاب على تطبيق الرياضيات في مشاكل الحياه الحقيقية. ٦- الطلاب يشعرون بالاطمئنان والراحة.
ماهي المواضيع التي يستخدم فيها المعلم التكنولوجيا	يستخدم السبورة الذكية في جميع الحصص	يستخدم السبورة الذكية في جميع الحصص.	يستخدم السبورة الذكية في جميع الحصص.

ماهي الصعوبات التي يواجهونها الطلاب في الرياضيات	١- بعض الطلاب يواجهون صعوبة في فهم أن أي عدد نضربة بصفر يصبح الناتج صفراً. ٢- بعض الطلاب لديهم صعوبة في فهم أن الضرب لا يعطي دائماً نتائج أكبر.	١- الاقتراض من الصفر.	١- بعض الطلاب يواجهون صعوبة في فهم أن اي عدد نضربة بصفر يصبح الناتج صفراً. ٢- الطرح.
تأثير استخدام السبورة الذكية على تعليم وتعلم الرياضيات.	١- فيما يتعلق بالتدريس، ظهر هنا في هذا الدرس ليتم فتحة في اي وقت لاحقا. ٢- فيما يتعلق بتعلم الرياضيات، عموماً، كان استخدام السبورة الذكية قادرة على تحويل الطلاب الى أكثر حماساً و نشاطاً. ٢- بخصوص تأثيره على مواجهه صعوبات الرياضيات، كان قادراً على بناء ثقه الطلاب لتعلم الرياضيات في جو من المرح وبطريقة تفاعلية.	١- فيما يتعلق بالتدريس، كان قادراً على توفير الوقت. ٢- في تعلم الرياضيات، عموماً، مكنت هذه الأداه الحد من النتائج السلبية التي تنشأ من هذه الصعوبات. ٢- بخصوص تأثيره على مواجهة صعوبات الرياضيات اظهرت سرعة إستجابة الطلاب للتغلب على الصعوبة.	١- ساعدت في تحديد نقاط القوة والضعف لدى الطلاب. ٢- ساعدت في تحسين وتعزيز الذاكرة. ٣- تعزيز ثقه الطلاب، حيث أن الطلاب أصبحوا لا يترددوا في الإجابة على الأسئلة التي يطرحها المعلم.
التحديات التي يواجهونها المعلمين أثناء استخدامهم للتكنولوجيا	هذا المعلم لم يجد أي تحديات خلال استخدامه لهذه الاداة، وهذا يمكن أن يكون بسبب الدعم المستمر والتشجيع الدائم من المدير.	لم يجد أي تحديات. أيضاً بسبب دعم وتشجيع المدير لهم	لم يجد أي تحديات أيضاً بسبب دعم وتشجيع المدير الدائم لهم.

	المعلم الرابع	المعلم الخامس	المعلم السادس
وصف الفصل الدراسي بشكل عام	١- يوجد سبورة تقليدية. ٢- تم ترتيب مقاعد الطلاب بشكل تقليدي. ٣- لا يشغل الطلاب المقعد نفسه كل يوم. ٤- كان هنالك طاوله واحده وكرسي للمعلم. ٥- لا يوجد أي لوحات على الجدران. ٦- يوجد اربع نوافذ صغيره. ٧- لا يوجد مكان لتعليق حاجيات الطلاب.	١- يوجد في المكتبة طاوله كبيره واحده وحولها عدد من الكراسي. ٢- يوجد طاوله وكرسي للمعلم. ٣- مساحة المكتبة كبيرة مع نوافذ كبيرة. ٤- يوجد مجموعة من المواد المطبوعة و المسموعة. ٥- لا توجد أي تكنولوجيا	١- تم ترتيب مقاعد الطلاب بشكل تقليدي. ٢- يوجد سبورة تقليدية. ٣- يوجد طاوله وكرسي للمعلم. ٤- يوجد أربع نوافذ صغيره في هذا الفصل. ٥- لا توجد أي لوحة معلقة في الجدران.
وصف البيئة الصفية	١- يتعامل المعلم مع الطلاب بشكل ودي.	١- يتعامل المعلم مع الطلاب بشكل ودي.	١- يتعامل المعلم مع الطلاب بشكل ودي. ٢- يوجد صعوبة لدى المعلم في إدارة الفصل.
ماهي المواضيع التي يستخدم فيها المعلم التكنولوجيا.	لا يستخدم كلياً	لا يستخدم	استخدم اللابتوب و البروجكتر لمدة اسبوع فقط، ومن ثم رجع الى الطريقة التقليدية (بدون تكنولوجيا)
ماهي تأثير طريقة تدريسه على تعليم وتعلم الرياضيات.	١- إضاعة الوقت دون الوصول إلى الهدف الرئيسي من الدرس. ٢- فيما يتعلق بتعلم الرياضيات، عموماً هذا الاسلوب لا يشجع الطلاب لكي يتمكنوا من اجتياز الصعوبة. ٣- بخصوص تأثيره على مواجهة صعوبات الرياضيات، لاحظت أن الصعوبة تضاعفت بذلك	١- معظم الطلاب لا يريدون المشاركة مع المعلم لأن اسلوبه لا يحفزهم على رفع ايديهم للتفاعل مع المعلم. ٢- ساهم هذا الأسلوب لصرف انتباه الطلاب، ونتيجة لذلك وجدوا صعوبة في فهم الدرس التالي. ٣- كان من الصعب	١- خلال استخدامه للتكنولوجيا لاحظت أن التكنولوجيا قادره على توفير الوقت، مما سمح للطلاب ممارسة المزيد من الامثلة على الدرس. نتيجة لذلك، فإنهم يكونوا قادرين على تذكر الدرس بسهولة مما أدى إلى الزيادة بالثقة بأنفسهم. ٢- عند عدم استخدام

	من التغلب عليها	على المعلم مساعدة الطلاب في التغلب على الصعوبات، لأنه لم يتمكن من تقديم الدرس بطريقة محفزة و مسلية.	التكنولوجيا، وجدت العكس مما ذكرت أعلاه. مما أدى إلى عدم تذكر الدروس، و التي أدت إلى إنخفاض الثقة بأنفسهم.

Appendix 12

Examples of the hand-written notes of the interviewee's responses (Arabic)

١- هل تستخدم التكنولوجيا في الفصول الدراسية
لمساعدة الطلاب الذين يعانون من صعوبات الرياضيات ؟
إذا كان الأمر كذلك، لماذا قررتم استخدام التكنولوجيا ؟
إذا لم يكن كذلك لماذا لا تستخدم التكنولوجيا؟

المعلم الأول :
نعم، وذلك لأن الزيادة في التكنولوجيا في وقتنا الحالي
يجب أن تستغل من قبل المعلمين لإفادة الطلاب،
ولا ينبغي علينا تجاهله.
المعلم الثاني :
نعم، حقيقة حاولت اكتشاف أفضل طريقة لتدريس الطلاب
الذين يواجهون صعوبات في الرياضيات، لاحظت أن
التكنولوجيا تجعل الرياضيات سهله وممتعة. نتيجة لذلك،
الطلاب سوف يكونوا متحمسين لتعلم الرياضيات طوال
سنوات دراستهم. بالإضافة الى ذلك، تطوير المناهج
الدراسية في المدارس السعودية جعل المعلمين يستخدمون
التكنولوجيا لمواكبة هذا التغيير.
المعلم الثالث :
نعم، لأن التكنولوجيا تمت لتصبح جزءا أساسياً في حياتنا
اليومية، أنا أعلم أن الطلاب يستخدمون التكنولوجيا خارج
أوقات المدرسة. لذلك من خلال دمج التكنولوجيا في
التعليم سوف تجعل الطلاب يتشوقون لتعلم الرياضيات.

٢- ما هي أنواع التكنولوجيا التي تستخدمها مع هؤلاء الطلاب؟ لماذا؟

المعلم الأول:
السبورة الذكية، لسببين. الأول هو أن معرفتي بتأثير هذه السبورة على الطلاب الذين لديهم صعوبات في الرياضيات. ثانياً، الجهاز يجمع بين العديد من المميزات والخصائص في أداة واحدة. وتشمل هذه: عرض المعلومات في شكل مثير للاهتمام، تسليط الضوء على النص للفت الانتباه الى اجزاء معينة من الدرس، حفظ الدروس بسهولة وإعادة فتحه للطلاب الذين تغيبوا عن الدرس. بالإضافة الى ذلك، استطيع التوقف عند نقطة معينة للمناقشة وتبادل الأفكار.

المعلم الثاني:
السبورة الذكية، لأنها تقدم عروض الوسائط المتعددة والتي يمكن إستخدامها في تدريس الرياضيات، على سبيل المثال من أجل شرح مفاهيم معينة.

المعلم الثالث:
السبورة الذكية، وذلك لتشجيع مدير المدرسة المستمر لنا، وإعطائي مجال لحضور دورة تدريبية عن كيفية إستخدامها بشكل فعال.

٣- هل التكنولوجيا تساعدك في تغطية مفاهيم الرياضيات الأساسية في المنهج؟

المعلم الأول:
نعم، وخاصة بعد تطوير مناهج الرياضيات.
المعلم الثاني:
نعم، وبشكل كامل بعد تطوير مناهج الرياضيات.
المعلم الثالث:
نعم، بعد تطوير مناهج الرياضيات من قبل وزارة التعليم.

٤- هل تعتقد أن التكنولوجيا تساعد الطلاب الذين يعانون من صعوبات تعلم الرياضيات، وإذا كان الأمر كذلك، كيف يمكن أن تساعد المتعلمين على التعلم؟

المعلم الأول:
نعم، تلفت انتباه الطلاب وتزيد من دافعيتهم نحو تعلم الرياضيات.
المعلم الثاني:
نعم، تقلل الصعوبات على الطلاب.
المعلم الثالث:
نعم، تعزز الثقة لدى الطلاب نحو تعلم الرياضيات وتساعدهم على تذكر المفاهيم واسترجاعها بسهولة.

٥- هل تعلمت شيء جديد عن إستخدام التكنولوجيا في الصف ؟

المعلم الأول:
نعم ، وذلك من خلال حضور دوره تدريبية .
المعلم الثاني:
نعم ، من خلال حضور دوره تدريبية.
المعلم الثالث:
نعم ، من خلال حضور دورة تدريبية .

٦- ماهي الاسباب الرئيسية وراء قرارك في عدم استخدام التكنولوجيا لمساعدة الطلاب الذين يعانون من صعوبات الرياضيات ؟ (المعلم ، المدرسة ، الحكومة)

المعلم الأول:
المدرسة فقط
المعلم الثاني:
المعلم والمدرسة .
المعلم الثالث:
المدرسة فقط .

٧- بماذا تعتقد العقبة الرئيسية التي تواجه المعلمين عند استخدام التكنولوجيا مع الطلاب الذين لديهم صعوبات الرياضيات من حيث:
- تدريب المعلمين على استخدام التكنولوجيا؟
- دعم فني؟
- مواقف ومعتقدات المعلمين حول تدريس الرياضيات مع التكنولوجيا؟

المعلم الأول:
مواقف المعلمين ومعتقداتهم حول تدريس الرياضيات مع التكنولوجيا.
المعلم الثاني:
تدريب المعلمين.
المعلم الثالث:
الدعم الفني.

٨- هل تحتاج الى أي دعم إضافي لاستخدام التكنولوجيا، وإذا كان الأمر كذلك، ماهو الدعم الذي تحتاجه؟

المعلم الأول:
لا، وذلك لأن مدير المدرسة يساعدنا باستمرار على التغلب على المعوقات التي تواجهنا إثناء الإستخدام.
المعلم الثاني:
لا، وذلك لأن مدير المدرسة يشجعنا ويساعدنا على التغلب على المعوقات
المعلم الثالث:
لا، وذلك لأن مدير المدرسة يشجعنا ويساعدنا على التغلب على المعوقات.

Appendix 13

The educational system in the Kingdom of Saudi Arabia

The Royal Embassy of Saudi Arabia (2010) makes an assertion that Saudi Arabia education system has undergone a dramatic evolution ever since the time of its inception 78 years ago. Presently, the construction of education facilities is experiencing a boom in the country and this has resulted in the construction of over twenty-five thousand schools with more being constructed as time passes by. Today, all tiers of the society have access to education and with the government providing free education for all citizens. The school curricula comprise of traditional Islamic religious education mixed with other fields which are usually based on what prevail in the United States. The school calendar is usually modelled to follow the American system having academic period ranging from nine to ten months and interrupted by summer break and occasionally by some religious holidays that give everyone some time off (The World Factbook, 2010).

In the Kingdom of Saudi Arabia, education is a made compulsory for children whose ages range from of 6 to 15 years and with most of them studying in state schools. However, many public educational institutions consisting of primary, intermediate and secondary schools have been established in recent years within the country especially in larger cities. Schooling from primary to secondary takes 12 years to finish after spending 6 years in primary school, three years in intermediate school, and three years in secondary school. The academic load in secondary school is divided into Islamic studies, science, and administrative studies. A student must have to accomplish all these three areas before he/she becomes eligible to enter a university (Alsonbol, Alshabanh, & Mordi, 2008). Genders are segregated in all public schools and enrolment in all levels of general education has seen a remarkable increase from a total of 400,400 to 4.3 million students during the period starting from 1967 to 2003 (Ministry of Economic and Planning, 1970, 2005).

Three agencies namely: the Ministry of Education and the General Establishment of Technical Education and Vocational Training as well as the Ministry of Higher Education take care of all education matters in Saudi Arabia. Furthermore, a number of ministries and public entities have control over particular kinds of institutions, for instance those run by the Ministry of Health and the Ministry of Defence (Al-Dossary, 2008).

In 1952, Saudi Arabia established the Ministry of Education and tasked it with the responsibility of providing free and right education to all students, and these include students with disabilities (Al-Dossary, 2008). The Ministry of Education is also responsible for the establishment of new schools and the maintenance of old ones, provision and development of curricular, the establishment of in-service training programmes for teachers, and provision of adult education literacy (Ministry of Education, 2008). The Ministry of Education is also tasked with the task running of special education services meant for students with disabilities (Al-Dossary, 2008). The ministry is also responsible for certifying eligibilities required to handle these services as well as offering and providing special education services that cater for students who have disabilities enabling them to live and function safely and independently (Al-Mousa, Al-Sartawi, Al-Adbuljbbar, Al-Btal, & Al-Husain, 2006).

In 1980, the government of Saudi Arabia established the General Establishment of Technical Education and Vocational Training (Al-Dossary, 2008). This is the main government agency given the task of providing technical education and vocational training in the colleges of technology and vocational secondary schools, as well as vocational training centres. The agency also handles the supervision and training programmes which the government and other private agencies provide (Al-Dossary, 2008).

Technical teaching and vocational training are primarily aimed at grooming and training people to perform various activities – in the fields of industry, agriculture and commerce – that are necessary for the country’s economy. The technical education and vocational training provide Islamic values and general knowledge to those involved in helping them adopt the correct way of thinking and adjusting to the diverse environments. They also create the bases for the development of technical manpower that should easily handle any new development in technology, thus providing the right opportunity for any individual who wishes to learn a new provision or wants to continue training in order to reach the highest level within his physical and mental capability. The technical education and vocational training also help technicians to develop their skills and to continuously update their professional information, as well as to underline the importance and roles played by handicraft and vocational work in the progress and prosperity of the society. They also contribute to the decrease in the movement of the population to bigger cities by opening several vocation centres in every region of Saudi Arabia (Alkhteb, 1998).

In the year 1975, Saudi Arabia established the Ministry of Higher Education and charged it with the task of implementing the government's policies on higher education (Al-Dossary, 2008). Higher education is primarily aimed at entrenching the faithfulness of the learner towards Almighty God. Accordingly, the highest quality Islamic education is provided in order for the Saudis to be qualified to fulfil their obligation towards their country and contribute to its development, guided by the ideal principles of Islam. The objectives are also meant to lay out opportunities for gifted individuals to shine in their field in education, and to contribute in the field of research by playing a more positive role in those areas that contribute to world development in the fields of arts and sciences. Other objectives include the finding of solutions to technological roadblocks plaguing society today; encouraging the translation into Arabic, sciences and other knowledge that are useful, as well as encouraging authors to write science books that would be of help for science, and enable the country play vital role in the development of human society and civilization anchored on Islamic tolerance. Others objectives still include the provision of training services for students as a way of developing themselves, as well as guiding the human race to tread on the right path and endeavour to save mankind from the tendency of immersing himself in material lust and unethical susceptibility (Abdul-Jauad, 1998; Al-Hougail, 1998; Ministry of Education, 2004).

In the year 2007, there were fourteen government universities and three private universities, as well as thirteen private colleges and ten community colleges, together with eighteen teachers' colleges, and one hundred and two girls' colleges existing in Saudi Arabia (Ministry of Higher Education, 2007). Also students studying in these universities are given monthly stipends. Saudi Arabia today has twenty-four government universities and eight private universities, together with twenty-one private colleges. The Ministry of Higher Education is tasked with the responsibility of providing support services to all these universities and colleges, as well as supervising and co-ordinating of all programmes of higher education. The ministry also supervises the government scholarship programmes for all citizens of Saudi Arabia studying abroad (Al-Hougail, 1998). Students who are awarded scholarship to study abroad are provided with allowances covering their tuition fess, board and lodging, and transportation. Those who take up science or technology are given extra amount. Male students awarded scholarship are encouraged to take along their wives and children by providing them with financial incentives (Metz, 1992), and this practice has continued to this day. The wives of these scholarship recipients may also pursue their own studies since there are possibilities of providing funds for them to undertake such studies (Metz, 1992).

Education budget in the Kingdom of Saudi Arabia from 2008 to 2014

This is demonstrated in the 2008 budget among others, where the total expenditure is placed at SR (105) billion. This includes allocation for technical and vocational training. New capital budget total SR (39) billion. Included in this capital budget is the King Abdullah Project for Education Development which is costing SR 9 billion and the construction of 2074 new schools. There is also an ongoing construction of 4352 schools, and 2000 existing buildings undergoing rehabilitation. With regards to higher education, the new budget has provisions made for the University of Northern Boarder Region appropriations, the construction of a new university campus for girls in Riyadh, and the inaugurations of 41 new colleges. Also, the continuation of the scholarship programme in the field medicine and engineering as well as computer science, law, and accounting will take place next year. The new budget also calls for 7 new technical institutes to be opened for girls and the opening of 16 new vocational centres. Also, the plan to implement the National Plan for science and Technology costing SR 8 billion is currently being undertaken (Ministry of Finance, 2014).

In the year 2009, the total expenditure to be made is SR 122.1 (US $32.6) billion. This includes technical and vocational training. Also, the King Abdullah Project for Education Development costing SR 9 billion and the Education Development Holding Company created and approved recently have continued to be implemented. The new projects being undertaken are the construction of 1500 new schools with an additional 3240 currently under construction while 2000 existing school buildings are currently undergoing rehabilitation. With regards to higher education, the new budget made provisions in the appropriation for a new female university campus to be constructed at

Princess Norah University in Riyadh and the construction of a Medical City for King Saud University while there will still be a continuation of the scholarship programme next year. There is also the ongoing National Plan for Science and Technology costing SR 8.0 (US $ 2.1) billion (Ministry of Finance, 2014).

In the year 2010, the total expenditure is placed at SR 137.6 ($36.7) billion which represents more than 25% of the total appropriation for the FY 2010, an increase of 13% over the appropriation of the FY 2009. Included is the King Abdullah Initiative for Education Development costing SR 9.0 billion and which is being implemented through the Education Development Holding Company of the Public Investment Fund (PIF). Again, the new projects being undertaken are the construction of 1200 new schools with an additional 3112 currently under construction and the completion of more than 770 schools started in the FY2009 while 2000 existing school buildings are currently undergoing rehabilitation. With regards to higher education, the new budget made provisions in the appropriation, for the construction of four new campuses meant for the newly established universities. Also, the scholarship programme will continue to function next year, but this time, it will focus more on technical trainers (Ministry of Finance, 2014).

The total expenditure earmarked for 2011 amounts to SR 150 (US $40) billions which represents 26% of the appropriation of FY 2011. This amounts to an 8% increase over that of FY 2010 appropriation. Also included is the continuation of the implementation of King Abdullah Bin Abdulaziz Public Education Development Project (Tatweer) costing SR 9.0 billion being undertaken through the Education Development Holding Company of the Public Investment Fund (PIF). There are also new projects, which include the construction of 610 new schools, additional 3200 currently under construction, and the completion of more than 600 schools which started in the FY 2009. There are also 2000 existing school buildings currently undergoing rehabilitation. In the case of higher education, the new budget made provisions in the appropriation for the completion of the constructions of the campuses of the new universities which include the construction of the faculty hosing projects. Also the first and second phases of the scholarship programme will continue next year (Ministry of Finance, 2014).

The total expenditure for 2012 amounts to SR 168.6 (US $45) billions. This represents 24% of the appropriation of FY 2011 amounting to an increase of 13% above the FY

2011 appropriation. Again, King Abdullah Bin Abdulaziz Public Education Development Project (Tatweer) costing SR 9.0 billion being undertaken through the Education Development Holding Company of the Public Investment Fund (PIF) has continued to be implemented. Additionally, there are new projects involving the construction of 742 new schools, and another 2900 under construction at present while more than 900 schools that started in the FY 2011 are being completed, and 2000 existing school buildings currently undergoing rehabilitation.

In the case of higher education, the new budget made provisions in the appropriation for the establishment of electronic university and for the inauguration of 40 new colleges, and for the completion of the constructions of the campuses of the new universities which include the construction of the faculty hosing projects. Also the first and second phases of the scholarship programme will continue next year. So far, the number of students studying on scholarship grants overseas has surpassed 120000 (Ministry of Finance, 2014).

The total expenditure for 2013 amounts to SR 204 (US $54.4) billions. This represents 25% of the appropriation of FY 2013 amounting to an increase of 21% above the FY 2012 appropriation. There are also new projects that include the construction of 539 new schools at a cost of SR 3.9 ($1.0) billion. This is in additional to the 1900 schools that are currently under construction, and the completion of more than 750 schools that started in the FY 2012. All these helped in the reduction of leased schools to 22%. This reduction is more than 33000 school compared to the 41% three years before. The budget includes appropriation for constructions that would help increase the number of school classrooms. It would also help rehabilitate 2000 existing school buildings to ensure that safety measures are improved.

In the case of higher education, the new budget made provisions in the appropriation for the Saudi Electronic University and the inaugurations of 15 new colleges, as well as the completion of the constructions of the campuses of the new universities that include the construction of the faculty hosing projects and the construction of three new university hospitals. The scholarship programme recorded the number of students studying on scholarship overseas to be over 120000. This numbers excludes dependents who also receive support from the government. All these expenditures amount to over SR 21.6 ($5.8) billion. There are additional new projects that include the construction of new technical colleges and institutes, which cost of SR 3.5 ($0.9) billion. It also includes appropriations for the inaugurations of new colleges and institutes (Ministry of Finance, 2014).

The total expenditure for 2014 amounts to approximately SR 210 (US $56) billions, which represents 25% of the appropriation of FY 2014 amounting to an increase of 3% above the appropriation of FY 2013. In the appropriation of the new budget are new projects that call for the construction of 465 new school buildings, which would cost approximately SR 3 (US $0.8) billions. These are in addition to the 1544 school buildings that are currently under construction, and the more than 494 schools already completed in the FY 2012. The budget also includes, in addition, appropriation that would help increase the number of classrooms constructed and the rehabilitation of existing school buildings numbering approximately 1500.

Regarding higher education, the new budget has appropriations that include the completion of the rehabilitation started for colleges for girls in many universities as well as for the inaugurations of 8 new colleges and the completion of the new universities' campuses that include housing meant for faculty members as well as other facilities. Regarding the scholarship programme, a record number of 185,000 students are studying on scholarships grants overseas. These include the dependents of the scholarship awardees that are also studying overseas and are being supported by the government. The expenditures for all these amount to over SR 22 (US 5.9) billions. There are also appropriations made for the construction of new vocational and technical colleges and institutes amounting to approximately SR 5.2 (US $1.39), and additional appropriation for existing projects that cost approximately SR 500 (US $133.3) millions (Ministry of Finance, 2014).

It will be noticed that a dramatic increase from 105 to 210 billion in expenditures occurred between 2008 and 2014. This is because the Saudi Arabian government is constantly making efforts to improve its education and its planning process in development. A conclusion can be made based on the government's efforts and expenditures made during the past several years as previously explained.

Appendix 14

Overview of Learning Theories

According to Hammond, Austin, Orcutt and Rosso (2001):

> *People have been trying to understand learning for over 2000 years. A debate on how people learn began at least as far back as the Greek philosophers, Socrates (469–399 B.C.), Plato (427–347 B.C.), and Aristotle (384–322 B.C.). The debates that have occurred through the ages reoccur today in a variety of viewpoints about the purposes of education and about how to encourage learning. To a substantial extent, the most effective strategies for learning depend on what kind of learning is desired and toward what ends*. (p. 3)

Aristotle was a student of Plato who in turn studied under Socrates. They asked: Do we discover truth and knowledge to be inside us (rationalism), or do we discern through our senses that knowledge and truth are beyond ourselves (empiricism)? (Hammond et al., 2001). It was Plato's view that self-reflection consistently results in the realisation of knowledge and truth. On the other hand, the view of Socrates was that the most effective method of acquiring some kinds of knowledge is by the utilisation of rational thought (Hammond et al., 2001). According to Monroe (1925), Plato concentrated on the dialectic method, which states that in order to find truth using oratory methods, one must engage in dialectic conversation and speak persuasively.

Educational psychologists and researchers have posited many theories to explain what the nature of Learning is, how people learn, how the mind acquires knowledge, and how one student can influence the learning of another through teaching (Alexander & Winne, 2006). As a result, teachers are able to use appropriate teaching and learning methods in the classroom (Alexander & Winne, 2006). According to Hammond et al. (2001), we have been presented with a number of concepts by educational theorists concerning the way in which people acquire knowledge, which have a realistic significance for teaching. It has been discovered through research work that the brain has a function in the learning process; for example, the method of formulation of the learning environments is significant; the foundation of learning depends on how we make associations and links; the learning process develops in specific social and cultural environments; and also, the various forms of people's thoughts and feelings, concerning how they learn, has an influence on the progress of their learning.

It is important that teachers recognise that there are many differences between students, such as intellectual capacity, rate of cognitive development, perceptual processes and general attitude, all of which account for variations in performance or behaviour (Farooq, 2011*)*. According to Chiang (2010), it is of major importance that prospective teachers are motivated by their trainers to examine their personal inspirations and anticipations, and to consider the multiplicity of their functions and objectives. Furthermore, there is a requirement that prospective teachers are habitually asked to visualise their profession and to reflect upon the implications of their opinions and activities, in view of the potential effect they may have on their students. Therefore, by giving trainee teachers the opportunity to build their personal knowledge and to comprehend learning theories, in the future they will be able to make essential connections between their theoretical knowledge base and the practice of teaching (McInerney, 2005). Simply put, if a teacher does not know how students learn, how can he or she help their pupils to learn more effectively?

There are many different approaches to learning but the two main learning theory categories are behaviourism and constructivism. Behaviourism is focused on observable behaviours, whereas constructivism is focused on learning students constructing new ideas through their current or past knowledge (Ormrod, 2008). These two theories will be focused upon because they have been most influential in education.

To fully understand all educational theories, it is first necessary to define learning and theory.

Definitions

Learning/ Learning is a term that does not have a universally accepted definition by theorists and researchers (Shuell, 1986). The following is a general definition of learning. According to Schunk (2011), learning represents a lasting change in behaviour, or in the ability to behave in a certain way, which is the product of practice or other manifestations of experience. Lachman (1997) noted that most textbooks define learning as the relatively permanent change in behaviour brought about as a result of experience. Thus, the definition of learning has been seen as a basic functional change that represents the effect of experience on behaviour (De Houwer, Barnes-Holmes, & Moors, 2013).

However, Domjan (2010) argues that this definition is unsatisfactory because it is a simple functional definition. Similarly, Ormrod (1999) argues that learning can occur without a change in behaviour. A study conducted by Tolman and Honzik (1930) aimed to investigate latent learning in rats, wherein three groups of food-deprived rats were placed in mazes with food at the centre. Tolman and Honzik observed the rats' behaviour each day for two weeks. The researchers found that learning can happen without any change in behaviour because the Groups 2 and 3 must have been learning at the same rate as Group one for the first ten days of the study even though the way they behaved did not show acquisition of learning. Essentially, the levels of learning were not discerned. According to Tolman, performance, rather than learning, is affected by reinforcement, in the sense that reinforcement makes it more probable that a learnt behaviour will be manifested (Taylor & Mackenny, 2008). As a result, we cannot define learning in terms of changes in behaviour.

On the other hand, also defining learning in terms of mental mechanisms has some disadvantages. As argued above, learning has been defined functionally as a change in behaviour resulting from experience. The assumption is that learning can happen without a change in behaviour (e.g., Domjan, 2010; Ormrod, 1999); however, De Houwer et al. (2013) suggests that, eventually, to ascertain a mechanistic definition, some type of change in the organism must be spotted – a type of change that is generated by a type of experience. This is extremely unattainable in the light of the fact that it is, at present, not obvious as to what precise changes occur in the organism due to experience, or how to verify whether such an alteration has indeed happened. Therefore, due to the mechanistic definition of learning, it becomes hard to establish the occurrences of learning, and consequently study learning. A return to the monitoring of behavioural changes appears to be the only alternative.

Theory/ Generally, theory refers to a set of assumptions and propositions backed by evidence that enables us to identify a problem, and then to identify how to instigate change (Cherry, 2010). In addition, theory is an ordered group of assertions regarding generic behaviour or structure, considered to be true through an appreciably wide range of particular occurrences (Sutherland, 1975). The principal objective of a theory is to provide answers to questions of how, when, where, or why; on the other hand, the objective of a description is to provide answers to the questions of what or who (Bacharach, 1989).

Historical roots of constructivism

Constructivism has deep historical roots, dating back to Socrates' dialogues with his followers, to whom he posited questions; these questions were designed to lead his followers to realize for themselves the weaknesses in their thinking, to construct meanings on their own and to build self-confidence in one's own thinking (Monroe, 1925). In the early part of the 20th Century, the American philosopher and educator Dewey (1859–1952) contributed the idea that educators should work with pupils' current understanding, while also considering the students' previous ideas and interests. This idea led to the evolution of constructivism (Dewey, 1961). Later, Piaget (1896–1980) proposed a constructivist theory based on discovery; this states that teachers should help students to construct knowledge that is meaningful for them rather than rely on passive reception (Piaget, 1977). In addition, Jerome Bruner was also interested in constructivist theory; his theoretical framework is based on themes, in which students are able to build new concepts or ideas based upon their current or past knowledge (Bruner, 1983).

Sociologists have added new perspectives to constructivist learning theory. For instance, Lev Vygotsky (1896–1934) was interested in the social aspects of learning, which are most often associated with social constructivist theory (Vygotsky, 1978a). He emphasized that knowledge is first constructed in the social environment (Vygotsky, 1978a). In this century, Karagiorgi and Symeou (2005) state, the current perspective of learning is a constructive which is uniquely different, as it is productive, self-regulated, positioned and collaborative. With the immediate availability of information in today's world, it is possible for constructivism to develop into a guiding theoretical basis and supply a theory of cognitive development and learning with a capacity of application to many objectives of learning.

Behaviourism

The historical roots of behaviourism theory go back to the school of psychology founded by Watson (1878-1958) and Skinner (1904-1990) (Parkay & Hass, 2000). The central premise within behaviourism is that certain aspects of human behaviour can be described, observed and measured. Learning is therefore defined as any change in behaviour on the part of the learner (Parkay & Hass, 2000). A key element in behaviourism is that positive reinforcement can lead to changing behaviour (Parkay & Hass, 2000); in other words, in this theory success depends on each student's stimulus and response.

Watson used Pavlov's findings on animal responses to stimuli as a basis for his work. Ivan Pavlov was examining the digestive process in dogs to study the interaction between salivation and the stomach. He found that these are closely linked by reflexes in the autonomic nervous system (Thomas, 1997).

According to Webb (2007), the basis of Watson and Skinner's behaviourism is a positivistic view of science, being a reductionist opinion in that all that is considered is the connection between sensory stimuli and the unique corresponding response. However, Skinner developed a more comprehensive view of conditioning; he used the term operant conditioning (also known as instrumental conditioning) in his research on animals, which refers to a method of learning that occurs through rewards and punishments for certain behaviours (Skinner, 1972).

As mentioned earlier, behaviourism was the basic learning theory underpinning most teaching, which placed the responsibility for learning directly on the shoulders of teachers; it is based on the proposition that learning can measured through observations of student behaviours without recourse to inner mental states (Jones & Araje, 2002).

Despite the fact that behaviourism was the pre-eminent pattern in American psychology for a number of decades, it has now been superseded by a range of research findings that generated inconsistencies, which uncovered its restrictions as a comprehensive account of psychological functioning (Wakefield, 2007). However, there has been a move from behaviourism towards constructivism (Eisner, 1999), to identify cognitive processes in learned behaviours, which involves the investigation of thinking, perception, sentiment, creative ability, language, awareness, and learning (Harman, 2008).

Appendix 15

Jean Piaget and developmental psychology (1896-1980)

Piaget's theories focus on the development of the individual, without considering the socio-cultural context (Jones & Brader-Araje, 2002). Constructivism is clearly present in Piaget when he asked the question: what is the nature of knowledge and how does it grow and develop? (Jones & Brader-Araje, 2002). Moreover, he focuses on the active role of the individual in learning: "*…all knowledge is tied to action, and knowing an object or an event is to use it by assimilating it to an action scheme…*" (Piaget, 1967, pp. 14-15). According to Piaget's views on constructivism, our interpretation of reality is in a constant state of review and re-formation over time, in relation to experiencing new situations (Ültanır, 2012). This way, what remains is construction; and there does not seem to be a reason as to why it should be unacceptable to believe that reality, in its ultimate form, is in a state of incessant construction, rather than a state that involves the conglomeration of pre-constructed structures (Piaget, 1970b).

In Piaget's theory of development (1953), cognitive development emanates from two processes: adaptation and organization. In addition, adaptation involves two sub-processes: assimilation and accommodation. According to Piaget (1953), assimilation is when pupils take new information or knowledge into their existing ideas, and accommodation is when pupils change their cognitive structure to understand new knowledge. This adjustment process happens when we adapt our knowledge and information to include our current information (Powell, & Kalina, 2009).

Jean Piaget introduced the term schema, and emphasized the importance of schemas in cognitive development; these assist in organizing and interpreting information (Piaget, 1971). Simply, schema theory states that everyone has a mental structure of preconceived ideas; the important question that arises from this is, how are schemata created and modified? I shall try to answer this question through an example. When a young child knows that a horse is large, has four legs and a tail she will say that a cow is a horse when seen for the first time. If we explain to her that, no, she was looking at another animal that has specifications similar to a horse, and that it is called a cow. Accordingly, she will change her previous schema and created a new one for a horse (Cherry, 2010).

In Piaget's contribution to constructivist theory, he studied the relationship between children's cognitive development and age, from infancy through to adulthood. Piaget thought that there are four stages of cognitive development (Ültanır, 2012). The first is the sensor motor stage (birth to 2 years old); in this stage, Piaget concluded that the basis of a schema is being developed. He deduced that during the early stages children begin to understand some of the information they are receiving from their senses; this he called action schemas. The second stage is the preoperational stage (2-7 years old); during this stage children's thought processes are developing. Another aspect of this stage is that of symbolism, which means that the child is able to represent external objects through mental images and symbols. The third stage is the concrete operational stage (7-11 years old). During this stage, the thought process becomes more rational and mature. The fourth stage is the formal operations stage (11 to adulthood). In this stage, people can relate the logical use of symbols to abstract concepts (Ültanır, 2012).

Overall, it is clear that Piaget's theories of learning focus on development, and not on learning as such (Ültanır, 2012).

Appendix 16

Social constructivism

Social constructivism is a term that refers to the collaborative nature of much learning (Jones & Brader-Araje, 2002). Vygotsky is the major theorist of the social constructivists, which states that the process of cognitive development occurs in social learning and interaction, including expert knowledge, where students collaboratively work together to accomplish tasks (Jones & Brader-Araje, 2002). The building of knowledge happens within a social setting where cooperation between students and students and between experts and students takes place on real-life issues or assignments, which contributes to the language, abilities and experience of each individual, as moulded by their specific culture (Vygotsky, 1978b).

Furthermore, Vygotsky argued that language plays a significant role in enhancing thinking, in developing reasoning and in cultural activities: Language is the principal means by which thought is promoted, interpretation is enhanced, and cultural enterprises, such as reading and writing are enabled (Vygotsky, 1978b). In addition, Vygotsky argued that language is the main tool linking the child with the external world: It is in a later stage of their development when children experience the most drastic change in their ability to use language as an instrument to solve problems. At that point of development, the socialised speech (formerly employed for addressing an adult) is turned inward. Children appeal to themselves, rather than to the adult; therefore, as well as its interpersonal function, language acquires an intrapersonal one (Vygtosky, 1978b).

Assumptions of social constructivism

Underpinning social constructivism are particular assumptions concerning reality, knowledge, and learning. It is necessary to understand these assumptions in order to implement the models of instruction based on social constructivism (Kim, 2001).

With respect to reality, social constructivism assumes that it is constructed by human activity. Kukla (2000) argues that the characteristics of the world are jointly created by the members of a society. Social constructivists believe that reality cannot be ‘discovered’ because it does not exist independently of social invention (Kim, 2001). In regards to knowledge, social constructivists, including Ernest (1991), Gredler (1997), and Prawat and Floden (1994), hold that it is socially and culturally constructed. Meaning is created by individuals via their relationships with other people and with their environment. Finally, learning is considered by social constructivists to be a social phenomenon. This means, as McMahon (1997) argues, that learning does not occur solely within the individual's mind, nor is it merely the acquisition of behaviour patterns moulded by outside influences. Instead, being involved in social activities is essential for meaningful learning.

Social context for learning

Wertsch (1991) discuss two main features of the social context which have a significant impact on the nature and degree of learning. The first is the historical developments which a learner, as a member of a certain culture, inherits from other members of this culture. Systems of symbols, including language, logic, and mathematics, determine what is learned and how learning takes place; individuals learn these systems throughout their lives. In addition, the kind of interaction the learner has with knowledgeable individuals in society has a significant influence. The shared meanings of key symbol systems, and how these are to be used, can only be learned through interaction with more knowledgeable members of society. Young children develop their cognitive skills through their interactions with adults.

General perspectives of social constructivism on learning

For social constructivists, the circumstances in which learning takes place, as well as the social influences which students bring to the learning environment, are critically important (Kim, 2001). Gredler (1997) has identified four broad perspectives through which we can understand learning processes in the social constructivist framework.

First, the cognitive tools perspective concentrates on the development of cognitive skills and techniques. Researchers have found that learners participate in learning activities which include hands-on, project-based methods in addition to the use of discipline-based cognitive tools (Gredler, 1997; Prawat & Folden, 1994). Working in a group, the students jointly create a product and impart a shared meaning to it through this social learning (Kim, 2001).

The second perspective is idea-based social constructivism. This prioritises key concepts in different subjects for learning – for example, part-whole relations in mathematics, point of view in literature, or photosynthesis in science (Gredler, 1997; Prawat, 1995). Gredler (1997) argues that such concepts extend students' perspectives and constitute crucial foundations for their learning and the construction of social meaning.

Third, the pragmatic or emergent perspective is the view that implementing social constructivism in the classroom ought to be done as the need arises (Gredler, 1997). Supporters of this approach (Cobb, 1995; Gredler, 1997) maintain that knowledge, meaning, and an understanding of the world are developed in class through the combination of the view of the individual and that of the group as a whole.

The fourth perspective, the transactional or situated cognitive perspective, emphasises how people relate to their environment. While individuals are a component of the constructed environment – which includes social relationships – the environment is also part of the individual's personal makeup (Bredo, 1994; Gredler, 1997). When a person thinks, he or she is interacting with the environment (Kim, 2001). Consequently, an alteration in the environment or social relationships in a group will cause a change in each person's activities (Bredo, 1994; Gredler, 1997). This means that learning should not occur in isolation from the broader environment (Kim, 2001).

Social constructivism in mathematics education

Social constructivism is promising to mathematics education, since it explains how subjective knowledge develops through this theory (Raghavan, 1994). Ernest (1991) relied on three principles to describe mathematical knowledge as a social construction. The first is that human language plays a key role in social construction, and mathematical knowledge consists of linguistic knowledge, conventions and rules. The second is that there is a necessity to utilise interpersonal social processes in order to convert a person's subjective knowledge of mathematics into an appropriate objective knowledge of mathematics. The third is that objectivity itself will be comprehended as being social.

Overview of social constructivism

Instead of focusing only on the justification of mathematical knowledge, social constructivism – similarly to quasi-empiricism – is principally concerned with the development of such knowledge (Ernest, 1991). Mathematical knowledge which has been recently acquired may be classified as objective or subjective knowledge. Social constructivism is unique in that it not only takes both types of knowledge into account, but it also views them as existing in a mutually productive relationship (Ernest, 1991). Philosophers like Popper (1979) quite frequently discuss these two forms of knowledge together, but they rarely consider the connections between them, as philosophy does not tend to deal with the development of knowledge. Objective and subjective knowledge are connected, in social constructivism, in such a way that each kind of knowledge plays a role in the generation of the other. According to this model, newly obtained mathematical knowledge is transformed from subjective knowledge into objective knowledge; initially a personal conceptualisation, it becomes objective knowledge through being made public, as this entails analysis, revision, and acceptance by others (Ernest, 1991). This objective knowledge then becomes an individual's subjective knowledge when he or she learns mathematics – during this process, the knowledge is internalised and reconceptualised, thereby becoming subjective. Subsequently, this subjective knowledge is published so that it is made objective, and so the cycle continues. In this way the two kinds of mathematical knowledge, subjective and objective, influence each other's development and revision (Ernest, 1991).

According to Ernest (1991), there are seven principal assumptions underlying the social constructivist analysis of the generation of knowledge, which are the following. First, it is assumed that a person has subjective knowledge of mathematics. The distinction between subjective and objective knowledge is a crucial one. Mathematical thinking, which includes not only mathematical knowledge but also the process of acquiring it, is subjective. To a great extent mathematical knowledge is reconstructed objective knowledge, as it is developed through learning; however, under particular conditions, the individual forms his or her own personal conceptualisation of this knowledge. In addition, fresh subjective mathematical knowledge is generated by individuals as they employ their existing knowledge to develop mathematical creations of their own. Second, publishing mathematical knowledge is a necessary, but not sufficient, condition for its transition from subjective to objective knowledge. A person's subjective mathematical knowledge becomes capable of being transformed into objective knowledge once it is made public. Whether it does become objective knowledge is determined by whether it is accepted by others. However, it remains the case that the knowledge must actually be made public in some way – verbally, electronically, or by being written or printed – in order for it to be capable of becoming objective knowledge. (It is important to clarify that we are construing knowledge as incorporating propositions as well as the proofs which justify these propositions.) Third, mathematical knowledge which has been made public becomes objective knowledge via Lakatos' heuristic. According to Lakatos (1976) heuristic, published mathematical knowledge may be revised and accepted by society (and thus objective) because in being made public it is subjected to analysis and assessment by other people. While the resulting knowledge is still open to being questioned, if Lakatos' heuristic is applied successfully then this is sufficient for the knowledge to be accepted (albeit provisionally) as objective mathematical knowledge.

The fourth is that this heuristic approach relies on objective measures, which play a fundamental part in the creation of mathematical knowledge (Lakatos' autonomous logic of mathematical discovery was construed in philosophical, rather than historical, terms). These measures, which are employed to critically examine mathematical knowledge, involve common perceptions of valid deduction as well as other primary methodological presuppositions (Ernest, 1991). Fifth, in disparaging accepted mathematical knowledge, the most common criticisms arise from employing an impartial understanding of language. In this case, criticism is formed through the epistemological understanding of knowledge, through semantic conventions; whilst an understanding of mathematical methods exists, it is language that provides the common technique to approach criticism. As language is universally acknowledged, and is considered an objective approach, applying such a method to the rationalisation of mathematical suggests that this too is objective. Sixth, the objective knowledge of mathematics attained can assist in forming a subjective understanding, albeit in a remodelled sense, through internalization. The internalization of objective mathematical understanding, applied through linguistic convention, aids the creation of mathematical rubric, limitations and general principles. Through forming internal understandings, based on objective knowledge, this can lead to the construction of subjective understandings; this in turn allows for the progression of criticism towards mathematical knowledge, as well as the reconstruction of perceived mathematical principles. Seventh, mathematical understanding can be furthered, altered or reformulated through the theories and concepts proffered by individuals. When subjective knowledge has been ascertained, interlinked objective understandings can be broadened within related fields. In particular, employing heuristic techniques allows for prevailing concepts to be explored and understood in-depth.

Problems of social constructivism

This short summary immediately faces two difficulties, the first being that objectivity is identified with what is generally accepted by society (Ernest, 1991). Although at first it does seem objectionable to equate the fixed truths and absolute objectivity of mathematics with shifting and fallible social knowledge, it was established earlier that mathematical knowledge is invariably inconsistent and unreliable too. Consequently, we can reject the conventional idea that objectivity has features like being permanent and unchanging; we can also reject the usual arguments that objectivity is something which humans cannot achieve. Instead we shall assume, as Bloor (1984) does, that social acceptance is not only a necessary but also a sufficient condition for objectivity. However, we still need to demonstrate that identifying objectivity with social acceptance in this way enables objectivity to retain the characteristics that are typically associated with it.

The second difficulty with this account is that social constructivism becomes similar to empirical (e.g. sociological) analyses of mathematics (Ernest, 1991). Social constructivism, as a quasi-empirical discipline, must provide a wholly descriptive account of mathematics – including the practice of mathematics – which means that the division between mathematics and other fields is not as robust as is normally thought. Weakening such boundaries has the result that the philosophy of mathematics becomes more like the sociology, history, and psychology (when the knowledge is subjective) of mathematics, which is problematic because it suggests that social constructivism is more closely aligned with sociology, history and psychology than philosophy (Ernest, 1991). An example of this can be seen in Lakatos (1976) who, as was demonstrated earlier, conflates his analysis of the development of mathematical knowledge with an account of the historical progression of mathematics. This indicates that philosophical and empirical theories of mathematics can potentially be muddled together, and this is something that social constructivism must not do (Ernest, 1991).

Appendix 17

Common misconceptions and difficulties

The third misconception (and ensuing difficulties) arising from students in mathematics education is mathematical equivalence. Perry, Church, and Goldin-Meadow (1988) found that mathematical equivalence can be highly problematic for some students. For example, given a problem such as 2 + 6 + 9 = 2 + _, it is evident that large numbers of students are unable to answer equations that entail operations on either side of the equals sign (McNeil, 2013). In fact, this is such a common challenge for students in American that only around 20% of 7-11 year-olds can solve the problems correctly (McNeil, 2013).

Being able to explain the difficulties that young students often face regarding mathematical equivalence problems holds significant implications for wider research in the educational sector. Specifically, mathematical equivalence is an established tool that is proven to be useful for advancing theory and testing hypotheses in terms of cognitive development. Previous studies that explained the difficulties that students face with mathematical equivalence have given researchers knowledge of significant theoretical matters pertaining to cognitive development. For example, Alibali (1999) investigated the nature of transitioning between different levels of understanding when facing mathematical problems, and Perry (1991) found a correlation between children's understanding of procedures and their understanding of concepts, while McNeil & Alibali (2000) highlighted how achievement goals benefit learning. In addition, Cook, Mitchell and Goldin-Meadow (2008) explored the function of gesture in the process of learning. Siegler (2002) and Rittle-Johnson and Alibali (1999) were able to understand how prompting children to explain their processes aided conceptual change. Furthermore, McNeil and Alibali (2005) and Sherman and Bisanz (2009) explored context-reliance in terms of developing new knowledge, and finally, Hattikudur and Alibali (2010) examined the role of comparison in the promotion of conceptual understanding.

The fourth misconception and associated difficulties arising from students in mathematics education relates to fractions. According to Chapin and Johnson (2000), this topic has been more problematic to primary and middle school students than any other mathematics field. Indeed, mathematics educators feel that teaching fractions is a challenge in primary schools, and the main reason is that a deep conceptual understanding is necessary for success in learning fractions; it is the task of the teacher continually to assist and support students' understanding (Yoshida & Shinmachi, 1999). Undoubtedly, children are going to perceive fraction computations as haphazard, perplexing and easy to muddle up, unless assistance is provided to them in order to grasp what fractions are and what fraction operations involve (Siebert & Gaskin, 2006).

Many students have fundamental misconceptions and difficulties with fractions, such as those relating to the main understanding of how fractions and decimals work, and how pupils can construct their own fraction models; they also have difficulty in comparing common and decimal fractions (Seimon, 2006). In addition, some students appear not to understand that fractions are numbers (e.g., Domoney, 2002; Hannula, 2003). Kerslake (1986), in her report on some of the difficulties that students have with fractions, emphasises that students must understand fractions at least as an extension of the number system; this is because many difficulties arise when students do not see fractions as numbers, but they see them as parts of a quantity. Kerslake believes that the problem with fractions usually starts with students in elementary schools when teachers introduce fractions in the minds of students as parts of geometric pictures rather than as numbers. As a result, this misconception leads directly to another problem for those students.

Another misconception among students in primary schools is when they think that all fractions are halves. This is due to some students having difficulty with one meaning of fractions, which may be ambiguous, such as the part-to-whole relationship (Siebert & Gaskin, 2006). As Kosbob and Moyer (2004) argue, "*Children's understanding of the part-to-whole relationship is the foundation of rational-number knowledge and is fundamental to understanding all rational-number concepts…[C]onstructing the notion of 'fractional parts of the whole' is the first goal for children in understanding fractions*" (p. 376).

Another difficulty with fractions for students in primary schools is learning about equivalent fractions. According to Chan, Leu, and Chen (2007), there are five cognitive difficulties facing students with equivalent fraction concepts. They find it difficult to: partition fractions as a quantity; partition shapes into equal sub-parts; identify the whole; build sets of equivalent fractions; and master equivalent fractions as representational model distractions.

Some students misunderstand the number $5\frac{1}{2}$, thinking it to be less than 5. According to Brizuela (2006), this is because children's understanding of fractions is usually that they refer to “little bits”, without looking at the relative magnitude of different numbers. Moreover, we notice that some students in elementary schools do not understand these concepts in fractions, even with the help of their teacher. Simply, they see fractions as two numbers, one of which is above the other (Clark, 2010). For instance, when a teacher in the classroom is dealing with fractions, they may use a picture of five items, four of which are coloured; we understand that the teacher aims to show visually how these fractions are represented. Immediately the students will see this picture as four items out of the five, without understanding that it is one quantity (Clark, 2010). Indeed, according to Siebert and Gaskin (2006), in order for students to successfully form a meaningful perception of fractions and fraction operations, it is necessary that they view fractions in a different way than as mere combinations of whole numbers. Furthermore, according to Siemon (2006), students usually have difficulty in understanding the procedure for solving fraction problems because they view both the numerators and denominators in the same way, without understanding that different denominators reflect different sized unit fractions. Another misconception that students struggling with fractions have is in multiplying and dividing fractions. This occurs when students understand multiplication and division with whole numbers very well; for example, they know that when multiplying whole numbers, the answer is bigger, and when dividing whole numbers, the answer will be smaller. However, when they come to multiplying and dividing fractions, they will find the opposite to be true, which is that when multiplying, the answer will be smaller, and when dividing, the answer will be bigger) Clark, 2010).

The fifth misconception and associated difficulties that students have is division. The concept of division is a subject that is commonly found difficult by a substantial number of pupils and even educators. Parmar (2003) suggested that division, like other similar topics, is easier to understand when pupils are able to grasp its key mathematical concepts at an early learning stage, as division is an extension of mathematical basics such as multiplication, subtraction and addition. Fischbein, Deri, Nello, and Marino

(1985) explained that, in its most basic form, young children learn to multiply by learning how to master repeated addition, and learn how to divide by mastering repeated subtraction.

A number of scholars, such as Graeber and Tirosh (1990), Silver, Shapiro, and Deutsch (1993), and Cai and Silver (1995), have investigated children's difficulty with division tasks. These researchers discovered that young students were unable to sufficiently describe, in writing, their own solutions to problems when it came to division tasks. It has been suggested that children seem to find it challenging to make sense of the actual process involved in finding a solution to the mathematical issue. This results in many children being unable to describe why they have reached the conclusion they have reached, even when they are clearly able to understand the task itself (Silver, Shapiro, & Deutsch, 1993).

According to Horton (2007), teaching methods would be more effective if children were regularly asked to provide reasons, in writing, for their answers to division questions. Asking pupils to do this should encourage them to think about the processes involved in completing tasks, which is also more likely to highlight cases in which the pupil does not completely understand how the mathematical formula they are meant to use actually works, particularly in response to complicated mathematical problems. Additionally, of course, as pupils are rarely asked to provide reasons for their answers to questions, it may be that pupils avoid providing reasons or that they are not comfortable with having to do so.

The sixth misconception and difficulty that students have concerns understanding place value. There is a great deal of literature regarding students' misconceptions and difficulties with place value (e.g., Carpenter & Moser, 1984; Cobb & Wheatley, 1988; Hiebert & Wearne, 1992). Place value is defined as the value of the place or position of a digit in a number or series (Kamii, 2004). According to Kamii (1986), it is possible for this misconception in place value to continue with some students until sixth grade, as teachers present place value as a secondary concept (Skemp, 1989). From this perspective, and to reduce the misconception, students have to obtain certain skills before they learn place value, such as counting, natural numbers and sets of objects (Skemp, 1989).

The difficulties facing students in understanding place value is emphasised by a number of researchers who say that place value concepts and multi-digit number sense are often difficult for elementary students to grasp (Jones et al., 1996; Nataraj & Thomas, 2007; Varelas & Becker, 1997). In addition, studies have shown that students have difficulty in developing an understanding of multi-digit numbers, and researchers have found that students concentrate only on how numbers are partitioned, rather than how these values interrelate (Fuson, 1990).

There are many factors that can affect this difficulty in understanding place value. According to Cawley, Parmar, Lucas-Fusco, Kilian, and Foley (2007), place value is one of the most significant mathematical concepts in elementary schools. Cuffel (1998) believes that the teaching of these fundamental competencies needs to improve because there are a number of common difficulties related to place value. The first is estimation and rounding, which is an important skill in maths and everyday life, and which some students find difficult to understand, as they do not understand why they need to 'estimate'. The second is number system knowledge; pupils do not have the ability to relate a quantity to the numerical symbol that represents it, and this leads to a lack of understanding of place value, which causes difficulties for them. Teachers must help children overcome this difficulty by using alternative representations.

In addition, students who have difficulties with the concept of place value also have difficulties with algorithmic procedures, and if teachers do not help students with their difficulties, the gap will widen in those pupils when they have to handle more complex algorithms (Cawley et al., 2007; Nataraj & Thomas, 2007). Therefore, according to constructivism theory, the way to introduce children to new mathematical concepts is to "*construct a mental model that reflects the structure of that concept*" (Jones et al., 1996, p. 311). Moreover, another aspect of difficulties children have with place value is that conceptual understanding is symbolic representation. According to Varelas and Becker (1997), distinguishing between the face value of every symbol in a number and the complete value of the same symbol is something that students are unable to do. For instance, when teachers give students a number such as 37, and ask what the complete value of the digit is, they will answer that 3 represents 3 and 7 represents 7, but the correct answer is 3 represents 30 objects. They do not understand that the teacher is not asking for the face value of each digit. These students appear to have difficulty with place value, especially with symbols used to represent numbers and their quantities (Varelas & Becker, 1997).

It is important to look at this problem, as most mathematics teachers and experts agree that students must understand the basic principles of place value, not only to know place value positions but to apply their understanding of place value in other aspects in mathematics, such as numeracy (Ho & Cheng, 1997; Miura, Okamota, Kim, Steere, & Fayol, 1993; Resnick, 1983; Ross, 1986; Van de Walle, 2003). However, according to Irons (2002), it is not necessary for teachers to begin to teach students in the early stages at primary schools all of the intricacies of place value before the children engage in multi-digit addition and subtraction. Similarly, Baroody (1990) promotes an early exposure philosophy, suggesting that the tangible introduction of multiunit concepts soon after children start using two-digit numbers at school and discussing them across the primary forms may help children acquire a more solid foundation for comprehending multiunit meanings.

Appendix 18

The history of using technology in mathematics education

Technology has a long history in mathematics education. In the early part of the 20^{th} Century, public schools used audio-visual aids such as charts, lantern slides and pictures to help students visualize object or problems (Reiser & Dempsey, 2007). In 1913, Thomas Edison announced, "*Books will soon be obsolete in the schools. Scholars will soon be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture. Our school system will be completely changed in ten years*" (cited Saettler, 1990, p. 98).

During the 1920s and 1930s, radio was widely with hopes for its pedagogical value (Reiser & Dempsey, 2007). In teaching, radio was able to help teachers in acquiring gradual Deweyan techniques of teaching (Cavanaugh, Gillan, Kromrey, Hess, & Blomeyer, 2004). This method focused on learning from experience or activity-based learning, by engaging in thinking, planning, reflection and observation, to construct meaning in a way that was unique to each learner (Dewey, 1938). As suggested by Joplin (1995), the Dewey ways of education can be largely effective when the student is dynamically involved in the experience. Additionally, the educators, who developed programmes at school in line with the Dewey philosophy, attempted to prove that, when learning in the classroom is dynamically facilitated by the educator, students display more attention and participation (Bianchi, 2002).

In general, not all educational efforts in radio were praised; this is particularly apparent when one reviews of the literature. Clark (1983) concluded that radio did not influence learning. However, educational radio created a legacy for itself through the development of other technologies, such as the use of television and the Internet in education (Casey, 2008).

During the 1950s, 1960s and 1970s, television was the focus of attention. Television is an effective tool in education; it can help students to understand abstract ideas directly, and therefore both learning and remembering become easier (Bates, 1998). In addition, teachers can sense when students are bored in the classroom; the role of television at such a moment can help those students to watch a program that elevates their arousal levels (Reifler, Howard, Lipton, Liptzin, & Widmann, 1971), and then teacher continue his or her lesson.

Television can combine visual images, sounds and spoken and written language at the same time, which lead to retaining that information long enough to use it in their lives beyond school. In other words, television can help to increase students' capacity to receive information and to keep it in long-term memory, and pupils will use it when they need it. A study was conducted on the impact of combining multiple systems and presenting them simultaneously, in which the researcher posited two main hypotheses; the first is that when TV-based information uses only audio and visual information, this may reduce the students' understanding, leading to not retaining information in the immediate memory. The second hypothesis is that when TV-based information uses multiple formats, such as visual images, sounds, spoken and written language, this may help pupils to remember and understand to a greater extent (Kozma, 1991). However, several other researchers have studied the effect of combined use of audio and visual information on the education of students in primary schools. They have found that there is a negative effect on students' memory, which will compete for limited cognitive resources, and thus they cannot remember and understand the information already presented on television (Baggett & Ehrenfeucht, 1983; Beagles-Roos & Gat, 1983; Calvert, Huston, Watkins, & Wright, 1982; Hayes, Kelly, & Mandel, 1986; Neuman, 1989). Moreover, Reese (1983) found that the appearance of a great deal of text on the TV screen can affect learning negatively. In addition, Hanson (1989) suggested that when teachers add the text onto audio and visual information, this will distract the attention of students; they tend to focus on the text and drift away from the audio and visual information. As a result, this method can decrease the students' ability to retain the concepts and ideas presented through television.

The results of these two studies contradict previous researches that demonstrated the use of multiple systems within television programs, such as incorporating visual information, auditory information and spoken and written language onto the screen in order to enhance learning. On the contrary, these two studies emphasise that the effectiveness of audio-visual presentations is only better for those students whose attention is not easily distracted.

Television exerts a powerful influence on cognitive skills, imagination and the task perseverance of children (Gladkova, 2013). Salomon (1979) proved that when students watch television, especially with slow zooms into the details of a large picture, this can teach them to develop their visual analytic skills. Moreover, another study confirmed that television can help students connect to new information and to adapt their previous thoughts by drawing conclusions and creating interpretations of the text; these can enhance their own comprehension (Beagles-Roos & Gat, 1983). In addition, a study has also demonstrated that there is a relationship between television and maintaining an adequate level of engagement on the part of the students on a daily basis (Friedrich & Stein, 1973).

As we know, reading is one of the main academic focus areas in elementary schools, and teachers should build a solid foundation in helping students with their reading skills; there are many benefits to be gained from reading books. However, the ability to read does not develop naturally, without careful instruction, because some pupils do not develop the skills automatically or are not motivated to read. Let us return to the television; I found several researches emphasising that there are certain programs specifically designed for those students who have difficulty reading. For example, Hall, Williams, Cohen, & Rosen (1993) demonstrated that the program Ghostwriter can help compensate for a wide range of difficulties facing students in reading and writing, and that it can give them the motivation to work harder toward learning to read and write.

Similarly, there is another TV program called Infinity Factory, which was designed to help students who experience difficulty with reading mathematics, particularly in how to read the text in mathematics books, and Bryant, Alexander, & Brown (1983) found evidence that this program was successful in changing children’s attitudes and that it facilitated their learning how to read (Bryant et al., 1983).

Two important questions now arise having ascertained the effect of television on those pupils who have difficulty in reading mathematics. These questions are: why do we need to determine the impact of television on reading mathematics, and what does reading have to do with mathematics? I will answer these questions with reference to Borasi, Siegel, Fonzi, and Smith (1998), who suggest that in order to successfully read mathematics texts of a technical nature, it is essential for students to the capacity to decipher the mathematical symbols and language of such texts so as to elicit the information they contain and comprehend the meaning or solve the problem.

To return to my research questions, which relate to the teachers, I found several studies demonstrating that teachers play an important role in the use of educational television programs in classrooms through making decisions that significantly affect student learning. One such study was conducted by Char, Miller, Isaacson, and Briscoe (1993), who have pointed out that teachers must help students make connections between the television program and their learning, by removing all the obstacles that prevent it and by being able to comprehend not just how educational television programs work, but how they work for each pupil. The Planning and Evaluation Office at the US Department of Education (2000), asserts that professional development, which puts emphasis on certain strategies for employing technology for higher-order learning, leads to a rise in teachers' use of these strategies. Therefore, there is a strong association between this technology and teachers' attitude to employing it in the classroom.

As we know, after the use of television in education, many technologies that have a positive impact in the teaching of mathematics have appeared. However, I will focus on the role of computer use in the teaching of mathematics, because Saudi teachers use the computer frequently, and for multiple purposes.

The late 1970s to the early 1990s was the period in which computers began to used in education. For example, considerable importance was placed on the introduction of computers into Australian classrooms, and this was made explicit in a report sent to the Education Department from the Australian State of Victoria, which states that the rationale behind the teaching of computer at schools is mainly the need to prepare children for living in a society where reliance on widely-used computer technology applications is rapidly increasing (McDougall, 1980).

In primary schools, writing is a basic need during the process of mathematics learning because students must be able to write down effective notes in order to learn new knowledge; it is, however, a difficult skill to learn and master (Behrmann & Jerome, 2002; Lewis, 1998; Williams, 2002). Computers have word processing applications that can be used to improve the writing skills of children at school, thereby transforming technology from a barrier into an opportunity for success (Collier, 1983; Engberg, 1983; Fisher, 1983; Rodrigues, 1985). Sadowski (1991) worked in West Milwaukee schools as a teacher; he often used a computer in his laboratory to help students with their writing; there were a number of computers available for use for each student in the lab. For a period of three weeks, his students used the lab computers to analyse and improve their writing skills, and these included typing, spelling, saving and printing their work. After three weeks, Sadowski found that his students were able to edit easily on the computer, resulting in decreased paper usage; type fonts and sizes can be changed repeatedly, resulting in improved overall readability. Interestingly, the students helped each other when they faced any computing problems. In addition, Daiute (1985) found that word processors greatly assisted pupils, helping them, with increased speed and flexibility, to organize their ideas, relative to others who used pencil and paper; in addition, students can save the text in the digital memory for later changes.

Students who have poor vision usually require text materials in large letters, which make it easier to read, and they need compensatory skills and educational interventions to achieve educational goals. Mioduser, Lahav, and Nachmias (2000) observed a student who had poor vision, who was unable to read the task from the blackboard to an adequate degree. The student then used a word processor; the researchers found that her performance was improved through using simple computing tools. She concluded: "*The letters and the sounds helped me very much ... I would like to continue my work with the computer*" (Mioduser et al., 2000, p. 23-24).

However, there are also studies against the use of word processing. According to Cochran-Smith, Paris & Kahn (1991), word processing does not improve the quality of students' writing. In addition, Moore (1987) found that pupils who use pen and paper made fewer meaning-related changes in text than those students who used a word processor.

There is another computing tool in that can play an important role in mathematics education; it is called Microsoft PowerPoint. This is a powerful tool for making a presentation, by drawing the eye away from the speaker and towards the screen, to reinforce the message. Students usually learn better from words and pictures than from words alone. According to Paivio's dual coding theory of memory and cognition (1986), which was originated to explain the powerful effects that mental imagery has on memory, human cognition is distinctive because it has developed a specialist capacity to handle both language and nonverbal objects and situation simultaneously.

Furthermore, language has a distinctive nature because it directly handles linguistic input and output (in the shape of speech and writing), while simultaneously performing a symbolic function in relation to nonverbal objects, situation and conduct. In any representational theory, this two-fold functionality must be reflected.

Many studies have empirically tested this theory. For instance, Mayer and Anderson (1991) conducted a study to compare teachers who presented information at school with words and pictures together, with other teachers who used words in preference to pictures. The researchers found that the teachers who presented information with words and pictures were more effective than those other teachers; the main reason being that the human brain processes information better when it is accompanied by images. Similarly, Peek (1987) focused on the effect of a PowerPoint presentation on the ability to retain information for the future. He found that it is easy to retain information relating to familiar concepts, but that it is difficult to retrieve information relating to unfamiliar or unclear concepts. As a result, he found that pictures and words together tend to improve memory retention in pupils.

Harrison (1999) argues that PowerPoint is a tool that has become a presentation staple in the educational environment, and that enhances students' learning. He adds that if this is true, then the important question that arises is: does PowerPoint help students learn? He asks this because many researchers have found that multimedia presentations do not show an increase in student performance in schools (e.g., Stoloff, 1995; Susskind, 2005; Szaba & Hastings, 2000). This is due to the fact that some teachers use PowerPoint in a way that inhibits interaction between the presenter and audience (Driessnack, 2005); moreover, some teachers limit the level of detail, making reading the slide a challenging activity (Driessnack, 2005). This latter leads to reducing the analytical quality of presentations (Stein, 2006).

There is another type of technology which is called interactive whiteboards (IWB), and the first interactive whiteboards for use in the office were designed in 1990 by Xerox Parc (Greiffenhagen, 2000). In the educational sector, primary schools began to use interactive whiteboards (or IWBs) in the late 1990s (Higgins, Beauchamp, & Miller, 2007). The IWB system consists of these major components: projector, computer and display screen (Wood & Ashfield, 2008). One of the reasons for using IWBs as tool for education is because it offers the opportunity to incorporate a wide range of multimedia resources into one lesson; these include sound, pictures, written text, video clips, CD-ROMs, software packages and using the Internet (Ekhaml, 2002; Glover & Miller, 2001). A typical classroom IWB has a large touch-sensitive screen, making it highly visible (Smith et al., 2005), and it has many features that make it easy for students to write on using their fingers; anything written on it can be saved and revisited in subsequent lessons (Solvie, 2007). In other words, an IWB has the ability to record the actions taken by students on the board, affording the teacher the opportunity to measure each student's understanding of the lesson, and then to address any difficulties a student may be facing. Moreover, IWBs are an important tool in teaching mathematics, as it allows them to draw straight lines, squares, triangles and circles (Gage, 2002).

Many countries, including the USA, Canada, Australia and the UK, are enthusiastic about IWBs, as they have great potential as a tool to enhance teaching and learning. Therefore, these countries are spending a great deal on introducing this technology into their schools. For instance, the UK spent £25 million on interactive whiteboards in 2004. IWBs can support a variety of teaching styles, and recently in England there has been a resurgence in whole-class teaching, especially in mathematics (Reynolds & Farrell, 1996); indeed, many top-performing nations have adopted a significant amount of whole-class teaching for mathematics.

A number of studies have identified the potential benefits of IWBs for teaching. According to Carson (2003), there is a game called the number spinning wheel, the aim of which is to support and facilitate mathematics teaching. He suggests that this support is reflected in the process of facilitating whole-class maths discussions, engaging students in talking about their ideas and in the generation of theories. In addition, Edwards, Hartnell, and Martin (2002) found that whole-class IWB activities gave mathematics teachers the opportunity to track their students' progress, which helped them to obtain diagnostic information about each pupil's strengths, misconceptions and weaknesses in mathematics. This provides a solid basis for the teacher to address problems before they worsen and become difficult to resolve. Moreover, according to Latham (2002), mathematics teachers feel comfortable when using this technology, as it allows them to flip back and forth to review previous content without wasting time. Similarly, the North Islington Mathematics Project also found that IWBs provide smooth transition from one teaching point to another (Latham, 2002).

Although lessons may take a little more time to prepare with an IWBs (Glover & Miller, 2001; Greenwell, 2002; Levy, 2002; Ball, 2003), teachers report that when they manage their time correctly and take advantage of this technology (such as saving any changes or additions in the lesson materials to the computer, which they can re-use as needed), they find that they actually need less time to prepare lessons (Lee & Boyle, 2003). This emerged when one of the teachers interviewed by Levy (2002) asserted that lessons take a little more time to prepare with an IWB on the first occasion but "*all those resources that I prepared this year are now still there – I believe my work will be a lot easier from now onwards*" (p. 14). According to Glover and Miller (2001), teachers can save materials on IWBs as a way of teaching development predicated on reflections from year to year, not only from lesson to lesson.

Moving to the potential benefits of IWBs for learning mathematics, according to Beeland (2002), one of the most important advantages of IWBs is that they increase student motivation in the learning process, which can improve academic performance and attention in class. This is attributed to the fact that this technology engages all users through offering high-quality presentations (Becta, 2003); presentations are enhanced through integrating video, graphics, text and audio (Smith, 2000). IWBs also afford immediate and positive feedback to students when they answer their tasks correctly (Richardson, 2002); they can also present sound clips for students to correct, and can play tunes to signify repeated errors (Miller & Glover, 2002).

Another role for IWBs in learning mathematics is to support recall; students can remember what they have learned in a mathematics class because, as we know, multi-sensory input makes learning more memorable. According to Burden (2002), "*when I talk to the children about what helps them remember, they say they can still see the images in their mind, even after we have finished a lesson*" (p. 17). In addition, the teacher can exploit the IWB's versatility to move images or to zoom in when presenting the lesson, and can use a wide range of colours, all of which enhance the learning process (Damcott, Landato, Marsh, & Rainey, 2000; Bell, 2002; Levy, 2002; Thomas, 2003). For example, the mathematics teacher can use colour to enhance the understanding of the measurement of angles, the transformation of shapes, percentages and fractions (Clemens, Moore, & Nelson, 2001).

Sources of problems in learning mathematics

In developing countries, a large number of students at varying stages of their education have difficulty learning mathematics. There are many different causes of these problems, but five general issues stand out (Mundia, 2012). The first is that some students appear to be affected in a negative way by the commonly held belief that mathematics is a difficult discipline (Heward, 1996). According to Farooq and Shah (2008), perceptions of mathematics are critically important in the teaching and learning of mathematics, and they influence how students perform in the subject.

The second issue is that many students do not receive satisfactory instruction and thus do not experience achievement in mathematics (Mundia, 1996; 1998). According to Adeogun and Osifila (2008), the characteristics of teachers and the effectiveness of teaching methods play the most significant role in students' learning. Classroom management is vital for learners' success because teachers' communication of values is central to their teaching (Ylmaz & Çava, 2008). The attributes, skills and behaviours of teachers in the classroom influence the learning environment and consequently students' performance (Al-Agili, Mamat, Abdullah, & Abdulmaad, 2012).
Third, Somerset (1987) and Murray (1996) suggest that some students have difficulties stemming from the methods used to evaluate performance in mathematics. 'Evaluation' is defined by the National Council of Teachers of Mathematics (1995) as the process of acquiring information which informs decisions about students. Assessment can yield information to be used to evaluate mathematical education, but it does not necessarily entail a value judgement.

The fourth issue is that certain students regrettably have a learning disability which specifically hinders them from learning mathematics (Thornton, Tucker, Dossey, & Bazik, 1983; Hall, 1994; Mercer, 1997).

Finally, Kelly (1991) points out that some students may perform poorly owing to a low level of teaching and learning resources combined with an inferior quality of education which are the result of a lack of funding. According to Coombs (1970), education is made up of two components: inputs and outputs. Inputs are resources – human and material – while outputs are the aims and outcomes of education. Inputs and outputs jointly constitute a dynamic organic whole, and understanding or assessing an educational system in order to improve it requires investigating how one component influences the other (Jekayinfa, 1993).

What is leadership?

As is the case with several other terms, the literature includes extensively variable definitions of leadership. For example, Yuki (1998) describes existing definitions of leadership as being marked by subjectivity; he believes that there is not a single conclusive definition of it. Additionally, he perceives leadership as an intricate and multi-dimensional phenomenon; it is basically variable perceptions of the leadership concept that are unveiled through these countless definitions. As stated by Cuban (1988), although more than 350 definitions of leadership exist, there is no definite, well-defined understanding about the aspects that differentiate those who possess leadership qualities and those who do not. However, a helpful reference frame can be supplied through a functioning definition. The provision of direction and the practice of influence are two elements that are essentially included in the majority of leadership definitions. For the purpose of accomplishing common objectives, leaders motivate, and work collaboratively with, others (Leithwood & Rieil, 2003).

As far as the incorporation of technology is concerned, there has been a view that the role of the head teacher is vital to the successful adoption and utilisation of technology. Research reported by Sandholtz, Ringstaff, & Dwyer (1997) corroborates this perception; according to them, whether or not educators incorporate technology into their classrooms depends on some factors, an essential one of which is the extent to which educators are supported by head teachers. In 2001, Sandholtz conducted a study, in which he concluded that the extent of support provided by the head teacher assisted in identifying the extent to which technology is incorporated by educators in their classrooms. In his study, which examined professional development for the purpose of achieving better educators' efficiency with the assistance of technology, Mouza (2003) concluded that, to successfully incorporate technology, the support provided by the school's principal was crucial. As concluded by Ronnkvist, Dexter, and Anderson (2000), it is necessary that school principals offer the teaching staff two kinds of technological support; these are instructional support and technical support. The first type of support, the instructional, involves aspects such as training and guidance on educational ideas, instruction-based plans, and instrumental methods of teaching. The second type of support, the technical, encompasses aspects such as facilitating the obtainability of hardware and software, resources of technological means, professional progress and individual technical support.

Additionally, the obstacles to successful integration of technology can directly be impacted by school head teachers; these obstacles involve obtainability of technology, finding time for educators to get acquainted with technology, providing funds needed for technology support resources, including professional development and maintenance, and directly shaping the utilisation of technology through their own technological knowledge (Rodgers, 2000, cited in Suggs, 2009). Moreover, in April 1995, a survey discussing how technology should introduce changes and improvements into education was published by the Office of Technology Assessment. The main notion of the report, which was entitled: Teachers and Technology: Making the Connection was: "We will never effectively realize the potential of technology to change education unless we address the issue of involving our staff in the use of technology" (p. 51). As suggested by Smith-Salter (2004), handling this concern in an effective manner necessarily requires the role played by leadership in encouraging and outlining the staff's use of technology to be rethought. According to Mergendoller, Johnston, Rockman, and Willis (1994), head teachers play a vital part in encouraging the use of technology at school and in the effective incorporation technology into their schools (Barth, 2002). Likewise, the implementation of technology crucially depends on leadership by the head teacher. Research on organisational change supports these conclusions; a consistent finding has been that, for efforts to successfully achieve their intended results, there must be a dynamic administrative leadership, especially one provided by head teachers. Based on research, three significant functions are performed by leaders; the first is provision of direction, the second procurement of resources, and the third motivation of staff (Mergendoller et al., 1994).

The part played by leadership in the improvement of the learning process and school operations through technology utilisation was the central theme of the Technology Standards for School Administrators TSSA Collaborative (2001). The TSSA produced benchmarks that served as pointers to productive leadership and abilities needed for technology to be fully and successfully employed at schools. The benchmarks are delivered in the form of six standard statements, each with benchmark having a set of parallel pointers to performance. These benchmarks serve as parameters essentially connected with the head teacher's role. First, in relation to leadership and vision - Educational leaders stimulate a common vision for full technology incorporation and nurture a setting and a culture that play an auxiliary role in that vision's achievement. Second, in relation to learning and teaching - Educational leaders ensure that technologies are adequately incorporated into the layout of curriculum, into instruction-based strategies, and into learning settings for the purpose of maximally enhancing the learning and teaching process. Third, in relation to productivity and professional practice - Educational leaders, through the utilisation of technology, aim to improve their professional practice and achieve a better efficiency for themselves and for others. Fourth, in relation to support, management, and operations - Educational leaders ensure that technology is incorporated to support effective methods for learning and management. Fifth, in relation to assessment and evaluation - Educational leaders apply technology with the aim of preparing and executing all-encompassing methods to achieve a productive appraisal and evaluation. Sixth, in relation to social, legal, and ethical issues - Educational leaders are knowledgeable about technology-connected legal, social, and ethical matters, and produce relevant decisions in a responsible manner.

Appendix 19

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Obstacles to Technology use When Addressing Saudi Primary Students' Mathematics Difficulties

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***Abstract*— Despite the potential positive effects of using technology with students who have difficulties in mathematics in the Kingdom of Saudi Arabia and the great efforts made by the Saudi Government to improve the education system of the nation, which has included a continuous rise in the educational budget, there still remain some obstacles for some teachers when using technology, and while some of these teachers overcome these barriers, others do not succeed in this the challenge. This paper will investigate the barriers that teachers face when using technology in their classroom in primary schools, and why some overcame obstacles while others did not. Semi-structured interviews and observations were used in this research, which were undertaken with three mathematics teachers from school A which used technology, and the other three from school B, which did not use technology. We found that the major obstacle teachers face when using technology included the teachers' negative attitudes and beliefs about teaching mathematics using technology, the lack of training in using technology, and the lack of technical support. The head teacher's attitude also had a great effect on managing the challenges teachers faced, which affected teachers' decisions to use or not use technology in school.**

Keywords*— *Obstacles; Reasons to overcome/ not overcome

I. Introduction

There are some students who have difficulties with mathematics subjects at primary schools in the Kingdom of Saudi Arabia. Mathematics learning difficulties is a generic term referring to those pupils "who learn but misconceive, find prescribed steps hard to understand, pattern development, visualizing as well as misunderstanding structures" [6]. It is therefore not surprising to note that many students perceive mathematics as a difficult subject, as it consists of many areas that continue to develop in an increasingly complex way [22]. However, when technology is integrated with teaching techniques, it can promote the translation of mathematical concepts from one mode into another, thereby making ideas more tangible [21].

The Saudi Government has made significant efforts made to improve the education system of the nation, with one of the goals more effective use of technology in mathematics education. These efforts have included a continuous rise in the educational budget with SR210 billion ($56 billion) for educational development in the 2014 budget, which was double the budget of SR105 billion ($28 billion) in 2008 [11].

However, there are still some teachers who face obstacles in using technology, and some of these teachers try to overcome these barriers, whilst others do not succeed in this the challenge. Overall the results are not as impressive as expected by the officials, which has been demonstrated in a number of ways. For example, according to the study of TIMSS (2007), Saudi Arabia got an average score of 4 along with 8 science samples was about 403 less than the international average and also below many other countries that have almost similar cultural and economic context [13]. In addition, the country has been experiencing a vigorous debate on the educational crisis that is related to the learning process and teaching quality and has been contributing to the overall results and ranking in TIMSS research.

Therefore, the aim is to improve the system of education in Saudi Arabia through investigating and understanding the barriers that teachers face when using technology in their classroom in primary schools, and particularly why some overcame obstacles and why others did not. Thus, there are two key questions:

1. Why are some mathematics teachers overcoming the obstacles they face when using technology to benefit their students?
2. Why do some mathematics teachers not succeed in overcoming the obstacles that prevent them from using technology to benefit their students?

II. Theoretical Framework

The theoretical frameworks adopted to undertake this research include the Concerns-Based Adoption Model (CBAM) (CBAM: [9]; [16] and the Technological Pedagogical Content Knowledge (TPCK) ([17];[19]). To understand the challenges those teachers face when use technology, CBAM is adopted. The term TPCK is used to describe the knowledge that is required by the teachers for effective integration of technology into educational practices. This study uses TPCK as a framework to understand mathematics' teachers needs so that they can overcome the hurdles of introducing technology in classes.

III. Literature Review

A. Barriers to Using Technology for Teaching and Learning Mathematics

In the light of the use technology, researchers have found that teachers seldom use technology in the school classroom.

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For instance, in a large-scale survey of teachers, students and administrators by the Gates Foundation, Abbott [1] shows that more than 53% of teachers do not use technology regularly to help their students in the classroom. In 2005, another survey (by CDW-G) found that 80% of teachers use computers for administrative tasks only [14]. In this section, we examine certain researches in order to gain a better idea of some of the barriers to adopting and using technology for teaching and learning mathematics, with the ultimate aim of breaking down those barriers among teachers and technology in schools.

A study in the Kingdom of Saudi Arabia by [2], which used semi-structured interviews and observations with four mathematics teachers and 12 students at an elementary school, sought to build a picture on the effects of applying technology to the mathematical problem-solving abilities of primary school students who have dyscalculia. The study found evidence to suggest that there were positive effects using technology on the mathematical learning of Saudi primary grade students with dyscalculia. These include technologies which can give meanings to numbers, which can remove any necessary barriers to learning and enhance strengths for students with dyscalculia, boosting students' confidence, or which helps students to remember what they learned (because the brain can more easily understand and remember visual information). Although this study has confirmed the positive effects of technology on student learning, one of these teachers did not use it with his students for three reasons. First, the teacher simply needed to be trained to use the technology. Furthermore, there is no reward system in place for innovative teaching. Additionally, he thought that the traditional blackboard would make complicated problems more solvable. But now he has changed his mind about the value of technology and began using it. Therefore, further study could focus on the obstacles of using technology on primary schools to help students with dyscalculia in the Saudi Arabia because this study found evidence to suggest that there are a variety of obstacles, including the lack of teacher training in using it, especially with those pupils who have dyscalculia, both through the workplace and in training institutions.

Another barrier originates from a lack of technical support in school. [12] indicates a scarcity of on-site support as a reason quoted by teachers for not using technology in the classroom. According to [7], there is a lack of technical support available in schools generally, leading to equipment remaining out of use for long periods of time; this seriously inhibits the widespread use of technology. An example of this is highlighted in [5]; it took three weeks to replace an expired projector bulb. [18] discovered that teachers who attempted to perform a function on a computer failed as a result of technical issues, and that they would then not use a computer for a number of days. Sharing a similar view, [10] reported that there is a close relationship between technical assistance and barriers; barriers in this case represent a lack of technical support, and teachers will be discouraged from using technology if they know that no one will be on hand to offer immediate technical support.

Another study, by [15], investigated the reasons why mathematics teachers do not use technology in their teaching in order to support students; their research was conducted at a school where mathematics teachers rarely use technology with their students, despite the availability of hardware and software. According to the findings of the study, the resistance of individual teachers was linked to their beliefs about the teaching and learning of mathematics and their existing pedagogies. This involves their ideas about tests, apprehensions about time restrictions, and preference of certain text resources. The study also concluded that teachers with transmission/absorption views of teaching and learning, and pedagogy focused on the educator and the content, had an obscured view of the prospects of using computers in the area of teaching and learning mathematics. By way of comparison, a teacher who holds a view of teaching methods in line with the social constructivist learning theory and learner-focused education displayed a broader view of the computers' prospects in the teaching of mathematics.

In the viewpoint of teachers, the attitudes of school headmasters on technology play an extremely significant role in the encouragement of technology incorporation into school [3]. [4] examined the effect of seven aspects linked to school technology (planning, leadership, curriculum alignment, professional development, utilisation of technology, teacher open attitude to change, and teacher use of computers outside school). Powerful leadership in technology was found, through interviews with teachers and administrative staff, to have an impact in students' acquisition of content. Moreover, when headmasters had a positive stance on technology, this promoted the integration of technology into the classroom and spurred teachers and students to utilise technology more often [4].

Overall, many teachers face a variety of challenges when trying to effectively use technology into their classroom. The first barrier to using technology in teaching and learning mathematics is the lack of training courses for teachers on how to use technology effectively. This barrier was demonstrated in a study in the Saudi Arabia by [2]. The second barrier is the lack of technical support; this was addressed in [12], [7], [5], [18] and [10]. The third barrier that affects the use of technology with these students is the negative attitudes and beliefs of teachers towards the use of technology generally. This barrier was investigated in a study by [15]. The last barrier is the school leadership' attitudes toward technology: this was demonstrated in [3] and [4].

IV. METHODOLOGY

A. Data Collection Method

As suggested by [20], a case study is a term that is broadly used in relation to the investigation of a person, a group of individuals or phenomenon. In the view of [8], the term of case study is related to research work that is aimed at probing a small number of cases in great depth. Therefore, this case study was conducted at two primary schools in Saudi Arabia, with three male mathematics teachers in school A, who use technology with their students who have mathematics difficulties, and three other teachers in school B do not use it with their students.

Each one of these six teachers were interviewed and asked general questions about the use of technology (Part 1). Each was then observed in their classrooms and, finally, every teacher was individually interviewed and asked specific questions to address the research questions (Part 2). Interviews and observations were chosen as techniques for the purpose of this research and because data collected through interviews and observations can be compared. In addition, observations are crucial to see the effect of technology on the students' mathematical learning. However, the observations may not be enough, as there remain the need to investigate and understand the barriers that teachers face when they use technology, and why they overcame obstacles or why not.

B. Ethical Considerations

The study was conducted in accordance with the British Educational Research Association Revised Ethical Guidelines for Educational Research (2004) with ethical approval given by the School of Education's Research Ethics Committee at Durham University.

C. Data Analysis

Firstly, all interviews were recorded and transcribed verbatim after each session. The each transcript, interview data and observation notes were read and re-read. Secondly, thematic coding was used, underlining the text in different colours, and matched data in categories separately which allowed reduction and synthesis of large quantities of information. Thirdly, all the identified commonalities were divided into themes, and supported with quotes.

V. RESULTS

We found from the interviews' responses of all six teachers and the consequent observations, that the head teacher was the main reason behind their decision to overcome or not overcome the obstacles they face when using technology to help students with difficulties in mathematics. The principals of both schools played a great role in managing the challenges they faced with technology. This became evident when the head master of school A helped the teachers in overcoming the obstacles they faced when using technology by training teachers and through technical support, which reflected positively on teaching and learning mathematics, leading to a continued and enthusiastic use of technology. On the other hand, the head teacher in school B did not help or support his teachers in providing technology in school, nor help with overcoming the challenges they faced with technology because of his attitude towards technology in general, which reflected negatively on their enthusiasm to continue to overcome barriers such as the provision of technology in the school, and the lack of training and technical support, in spite of their belief that technology has a positive impact on teaching and in the learning of students who have difficulties in mathematics.

In addition, we can also find three subset reasons for these three teachers in school A being enthusiastic to overcome the obstacles they faced in the use of technology.

The first reason given by teacher one was his desire to take advantage of recent technological developments in his teaching practice. Throughout his teaching career, teacher two had used various methods to attempt to address the difficulties his students faced while learning mathematics. He found that teaching with technology facilitated learning through making the lessons more enjoyable and the topics easier to understand. According to teacher three, as technology is now so widely used for entertainment purposes by students in their daily lives outside of school hours, technology should be harnessed and applied to engage the students' interest within the classroom environment which would help stimulate their interest in the subject of mathematics, and also help them absorb the information more easily as a consequence.

The second is the way of structuring the topics after the development of the mathematics curriculum, which requires teachers to use technology to help them deliver and simplify information for students, as technology has now become an integral part of the curriculum.

The third is the teachers' belief that the technology has a positive effect on teaching and learning students with mathematics difficulties; this was proved through the interview responses and the researcher's observations.

However, it is interesting to find that the help and support of the head teacher is critical for these three teachers to achieve all the three points above easily. These include the provision of technology in each classroom through communicating with the Ministry of Education, encouraging teachers to use technology, giving assistance and support to overcome all the obstacles that prevent their use of technology, such as offering relevant training and technical support. The head teacher in their school was extremely supportive and enthusiastic towards technology; he was very creative in offering ideas to help his teachers exceed the challenges and make the most of the possibilities offered by the technology. For instance, making part of the teachers' evaluation scores on attending the necessary training, and providing technical support in the school. All these factors led these three mathematics teachers to continue successfully in the use of technology.

In regard to the other three teachers in school B, we found that there were reasons why they did not succeed in overcoming the obstacles they faced with technology. To identify these we need to revisit the previous chapter, which appeared in three positions as follows:

Firstly, we can find this in first dimension, when all the three teachers mentioned the reasons for not using technology with their students. These included the lack of a reward system

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from their head teacher for innovative teaching through technology, the lack of support from the principal in providing technology, appropriate training and technical support. Moreover, teacher three found that the advanced age of his head teacher was a barrier; also not receiving in-service training reduced the head teacher's enthusiasm for providing technology in his school, which impacted negatively on this teacher's decision to use the technology.

Secondly, we can see from the third dimension that all three teachers mentioned that the main reason behind their decision not to use technology to help students with mathematics difficulties was solely due to the school itself. By the term, school only, they were referring to the attitude of head teachers towards technology with regard to provision, integration and use within the classroom.

Thirdly, each teacher mentioned the meaning of the attitude of head teacher according to his own belief and experience. We noted that they agreed on certain points, such as when teachers four and six mentioned the advanced age of the head teacher and the lack of the director's knowledge regarding the positive impact of technology on students with mathematics difficulties, which are critical factors affecting negatively technology integration and use in schools, but they disagreed on others. This appeared when teacher five mentioned the attitude of the head teacher in general without further detail, and when teacher six added that the fact that the principal who had not graduated in any computer subjects would influence his belief and attitude toward technology.

However, it is clear from all the three points above that the attitude of their head teacher was the main reason for the teachers' own reluctance to overcome these barriers.

VI. DISCUSSION

It is interesting to mention the theoretical framework that has been selected for conducting this research, which included the Concern Based Adoption Model (CBAM) ([9]; [16] and the Technological Pedagogical Content Knowledge (TPCK) framework ([17]; [19]); neither of these is sufficient to explain the use and non-use of technology. Although these models were helpful they were not enough to look at the whole picture of how to achieve better use of technology. In this study, the TPCK model helped us think about content and the match between pedagogical content, but does not help us on teacher beliefs, concerns and motivations. In addition, the CBAM model helped us to identify teacher concerns but not school problems such as if a teacher does not have any technology, so we were still stuck.

This means in this study the researcher needed to take account of school level concerns and teacher level concerns and then use the TPCK framework. In other words, if the researcher only sorted out school concerns and teacher concerns (beliefs), then we can move to the TPCK model. This gives a really important explanation of why TPCK is only useful if you have other things sorted. Therefore, this model will be great if we work with a school that already has technology and support by the head teacher, such as school A, but not with school B which does not have technology. The following figure below illustrates when we can use CBAM and TPCK frameworks.

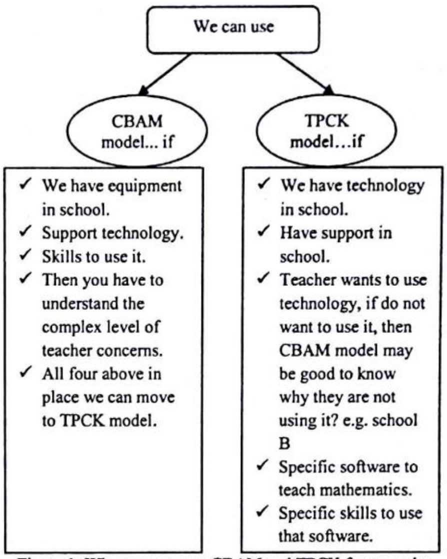

Figure 1. When we can use CBAM and TPCK frameworks

When we look at the figure above and the two school cases, we find that school B does not have technology, the head teacher does not support the teachers in terms of providing, integrating and using technology within the classroom, and finally teachers four and five do not have the skills to use it. This means we cannot address teachers' concerns because the technological support is still one of the main concerns. This also gave us an indication that in this case we cannot use the TPCK model, because there is no technology in this school. While in the case of school A, they have technology in school, the head teacher supports and encourages them to use it, and the teachers want to use it. This means the researcher can use the TPCK model with them to understand the needs of those three teachers for effective pedagogical practice in technology to help those students with mathematics difficulties. On the other hand, this model does not help us to know about teacher beliefs and concerns. Therefore, in this study the researcher needs to use both of these models, CBAM and TPCK, and also look at school problems. In addition, it becomes clear in this study that there is a hierarchy in models; school comes first and we need to understand teachers' concerns and then move to a TPCK framework (see Figure 2).

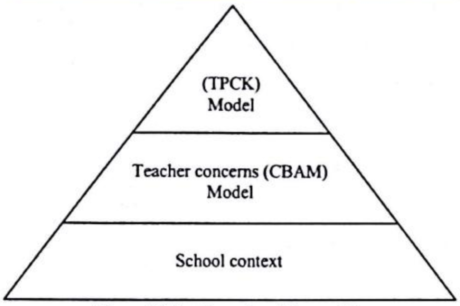

Figure 2. The hierarchy of the models

It is also interesting to mention that we can offer something that is very specific in my study. We can say that all the studies in the literature review confirm that, if we want to achieve teaching and learning with technology fully, these kinds of things have to be in place: head teacher support, training for teachers to use technology, technical support, and positive attitude towards technology. All these were important and my study confirms this, and these all need to be in place (head teacher support, training for teachers to use technology, technical support, and positive attitude towards technology), but the researchers stop at these barriers, which did not include the subject knowledge, this means we have to make a stronger mathematics connection. In other words, teachers have to use specific software to teach multiplication and subtraction, for example, well; and they need the software that leads them to represent multiplication and subtraction and they need to know how to teach multiplication and subtraction. We need good software and good knowledge, because even if we give teachers good software and they still are not able to use it, because their mathematics knowledge is not sufficient, this will lead them to not using it. All of these need to be in place for a successful use of technology.

Even specialists when devising the Tatweer project in Saudi Arabia, started to overcome these barriers quite well in most Tatweer schools and teachers, but they did not cover the subject knowledge development, and some teachers may be doing this by themselves. Because the project designed to support general teaching with technology but did not think about subject knowledge. In other words, the project did not design to support excellent mathematics teachers with technology. We think that, if we want to support teachers to develop their mathematics subject knowledge, we do not necessarily have to do a separate course on mathematics subject knowledge development, we can provide one training course about the ways of using technology to teach mathematics well, and at the same time, we will teach the teachers the mathematics.

VII. CONCLUSION

We found from the interviews' responses of all six teachers and the consequent observations, that the head teacher was the main reason behind their decision to overcome or not overcome the obstacles they face when using technology to help students with difficulties in mathematics. The principals of both schools played a great role in managing the challenges they faced with technology. This became evident when the head master of school A helped the teachers in overcoming the obstacles they faced when using technology by training teachers and through technical support, which reflected positively on teaching and learning mathematics, leading to a continued and enthusiastic use of technology. On the other hand, the head teacher in school B did not help or support his teachers in providing technology in school, nor help with overcoming the challenges they faced with technology because of his attitude towards technology in general, which reflected negatively on their enthusiasm to continue to overcome barriers such as the provision of technology in the school, and the lack of training and technical support, in spite of their belief that technology has a positive impact on teaching and in the learning of students who have difficulties in mathematics.

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Understanding technology use and constructivist strategies when addressing Saudi primary students' mathematics difficulties

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ABSTRACT: This paper will investigate the relationship between technology use and the use of constructivist strategies when addressing Saudi primary students' mathematics difficulties. Semi-structured interviews and observations were used for the purpose of this research, which were undertaken with three mathematics teachers from school A which used technology, and the other three from school B, which did not use technology. We found that technology can support constructivist approach when teaching and learning mathematics. Therefore, it is interesting to mention that the use of technology not only helps in increasing practice and motivation, but also can be used to help students regarding their misconceptions about mathematics consistent with constructivist and radical constructivist approaches.

KEYWORDS: Technology, Mathematics difficulties, Constructivist approach

I. Introduction

Technology is an increasingly important aspect of modern education, and its relevance is spreading to virtually every field [12, 22], and therefore has become an integral part of our daily life. Students want to bring what they are doing outside school into classroom, such as computer games, smart phones, social networking and MP3 players [13]. According to Natalie [26], outside the classroom, students are high engaged in technology. Therefore, if their interest is aroused in a subject through the medium of technology, students may be more eager to think very hard and learn new things.

With respect to beliefs, mathematics, to most students, is a complex and difficult subject, involving new language, and understanding space and quantity with particular precision [30]. Moreover, mathematics is possibly the only subject that involves such a gulf between an educator and pupil understanding. When the teacher is in front of the blackboard (or interactive whiteboard), the meaning of symbols and their relevant possible conclusions are absolutely obvious to him/her, but this could be completely the opposite for many pupils [30]. However, when integrated with teaching techniques, technology can promote the translation of mathematical concepts from one mode into another, thereby making ideas more tangible [34] and accessible. Furthermore, technology may enable students to access quality education, and to obtain the skills and knowledge they will need for solving problems [24]. According to Xin [41], students have different approaches to learning, but computer-assisted instruction can nonetheless have a positive effect, helping them to work together despite their differences. Individualized instruction can be given through a computer, allowing a student to observe the speed at which they achieve their targets, providing feedback on current performance, and maybe motivating students to continue with their tasks. Additionally, technology allows students to touch and see information, which facilitates comprehension through summarizing or abstracting, thereby increasing learning capacity [23]. In the light of a constructivist approach, many researchers e.g., [3, 6, 8] have studied the effect of constructivism on classroom practice. Therefore, this paper will investigate how the use of technology not only helps in increasing practice and motivation, but also we use it to support constructivist and radical constructivist approaches when helping students regarding their misconceptions about mathematics.

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II. Literature Review

A. Historical Roots of Constructivism

Constructivism has deep historical roots, some claim dating back to Socrates' dialogues with his followers, to whom he posited questions; these questions were designed to lead his followers to realize for themselves the weaknesses in their thinking, to construct meanings on their own and to build self-confidence in one's own thinking [25]. In the early part of the 20th Century, the American philosopher and educator Dewey (1859–1952) contributed the idea that educators should work with pupils' current understanding, while also considering the students' previous ideas and interests. This idea led to the evolution of constructivism [10]. Later, Piaget (1896–1980) proposed a constructivist theory based on discovery; this states that teachers should help students to construct knowledge that is meaningful for them rather than rely on passive reception [28]. In addition, Jerome Bruner was also interested in constructivist theory; his theoretical framework is based on themes, in which students are able to build new concepts or ideas based upon their current or past knowledge [5].

Sociologists have added new perspectives to constructivist learning theory. For instance, Lev Vygotsky (1896–1934) was interested in the social aspects of learning, which are most often associated with social constructivist theory [37]. He emphasized that knowledge is first constructed in the social environment [38]. In this century, Karagiorgi and Symeou [18] state, the current perspective of learning is a constructive which is uniquely different, as it is productive, self-regulated, positioned and collaborative. With the immediate availability of information in today's world, it is possible for constructivism to develop into a guiding theoretical basis and supply a theory of cognitive development and learning with a capacity of application to many objectives of learning.

B. What Is Constructivism?

Constructivism is a learning theory that explains human learning as an active attempt to build knowledge through the learner using their own experiences and mental activity [17]. According to Davis et al. [9], students are expected to formulate their own knowledge, both as individuals and by cooperating with others. As students attempt to solve problems that emerge in the environment, they are required to increase their knowledge with their toolkit of ideas and abilities. Other students and teachers constitute the community whose purpose is to supply the context, present the problems, and to provide the encouragement to motivate mathematical construction. Brooks & Brooks [4], claim that constructivism is not a theory regarding teaching, but rather a theory concerned with knowledge and learning, which describes knowledge as transient, evolutionary, culturally and socially mediated and therefore non-objective. This approach is principally predicated on the idea that it is only through their current understanding that students are able to grasp new situations. Learning is a dynamic process where students, by connecting fresh ideas with their current knowledge, form meaning [27].

A common thread in all of these definitions is the student's active participation in problem-solving by using prior knowledge and experience. In other words, learners are the makers of meaning and knowledge. In contrast to behaviourism, constructivists argue that "knowledge is not passively received but built up by the cognizing subject" [11, p. 182]. Constructivists focus on knowledge as a process, and behaviourists focus on knowledge as a product. Therefore, constructivists came to transform the focus from knowledge as a product to a process [16].

C. The Effect of Technology on a Student's Motivation

Many researchers agree that IWB has a positive effect on student motivation [14, 15, 20, 21, 31, 32, 33]. Wood and Ashfield [40] argued that the large screen and the multimedia capacity of the interactive whiteboard provided a means of engagement which subsequently improved student motivation. It is claimed by Levy [19] that students are motivated by IWBs to respond to questions asked by teachers as a result of the powerful visual and conceptual appeal of the depicted information and also because they enable students to apply a physical interaction with the board as they seek the answers. In the next part, the literature will show evidence from some studies that technology can increase the motivation of the students who have mathematics difficulties. In the next part, the literature will show evidence from some studies that technology can increase the motivation of the students who have mathematics difficulties.

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Torff and Tirotta [36] conducted research work to establish to what degree the utilisation of interactive whiteboard technology (IWB) contributed to the level of motivation in mathematics reported by upper elementary students. A total of 773 students (241 4th grade, 260 5th grade, and 232 6th grade) took part in the research study. The number of teachers who participated was 32, and 19 of them stated that they used IWB (the treatment group), and 13 of them noted that they did not widely use IWB (the control group). There were 458 students in the treatment group and 315 in the control group. According to the findings of the research study, a higher level of motivation was displayed by the treatment group students, compared with the control group students. Also, students whose teachers are supportive of the utilisation of IWB technology showed a higher level of motivation, in contrast to students whose teachers are less keen on the use of IWB.

Taylor [35] centred their research work on how teachers can increase student motivation by integrating interactive whiteboard into classroom teaching. The study involved three third-grade classrooms, with varying use of IWB. The analysis included details on multiplication fluency, the capacity to depict the mathematical concepts of multiplication, the opinions of students as indicated in the survey responses, together with end of unit assessment scores. There was an increase in student motivation relating to the use of interactive whiteboard in a very interactive student-directed method. Classroom students who used this interactive technology achieved a higher academic standard, and revealed more good opinions of the interactive whiteboard and mathematics.

D. The Effect of Technology on Save Teaching Time and Minimize Adverse Outcomes

Bidaki and Mobasheri [2] found that one of the perceived benefits of technology is saving teaching time. They conducted a study entitled "Teachers' Views of the Effects of the Interactive White Board (IWB) on Teaching" which was implemented in a local authority primary school in Aberdeen, UK. A total of 198 pupils in 7 classrooms from P1 to P7 participated. The information was collected from one interview with the head teacher and four interviews and five questionnaires with teachers. The study indicated participants believed that the IWB is able to improve pedagogical skills, enhance the attention of the students thus saving teaching time. Additionally, this technology may help to reduce the function of classroom teachers and develop an improvement in student skills, for example team work and discussion.

A number of other studies have also identified that Computer Assisted Intervention (CAI) is a useful tool for arithmetic support [7, 29, 39]. For instance, Wilson et al. [39] focused on how technology can help students with mathematics difficulties. They used The Number Race software, which is designed for children aged 5–8, to teach and train them through entertaining numerical comparisons. Researchers designed this software to provide intensive training. The game uses an algorithm, whose task is to establish the knowledge space of each child. The Number Race software experiment was carried out on nine children, during five weeks, using direct observation. They had to play a comparison game, in which there are two main screens. Each screen has a task, such as 4 + 5 = 9 and 3 + 3 = 6, although the quantity can be represented in a non-symbolic format, a symbolic Arabic format or a symbolic verbal format. In this situation, the student must carry out a numerical comparison task, choose the larger quantity, pick the screen with the larger quantity, and finish the game within a specific time limit. When the student completes the task in hand, the next task will be more difficult than the previous one. The computer will give the student who successfully completes the task golden tokens, which will help the student progress through the squares on the game board. The player can compete against the computer to make the task more challenging and fun. In higher levels, the student must add or subtract in order to make a comparison, and at the end, the children collect their reward and can start a new phase of play with a new character. The designers used a multidimensional learning algorithm to adapt the difficulty of the program, simulating the children's learning and helping them to learn using three dimensions of difficulty (distance, speed and conceptual complexity). These dimensions constitute the learning space, where children can be presented with a problem at any point in this space. After analysing the children's data through Matlab programs, they found that the software was successful and delivered the expected results, in addition, the researchers received a positive feedback from the students, parents and teachers.

E. The Effect of Technology on Boost Students' Confidence

A study was conducted by Alabdulaziz [1], the purpose of which was to investigate the effect of technology on the

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mathematics learning of Saudi primary students with mathematics difficulties, and to investigate the teachers' usage of technology with those students, and their perceptions about using this technology in Saudi Arabia. Overall, the research aims to encourage the use of technology in schools in order to help those students in Saudi Arabia, so that they may achieve their desired outcomes, as well as continue to improve their abilities. He used semi-structured interviews and observations to collect his data, interviewing and observing four mathematics teachers and 12 students at elementary school. Observations were crucial for seeing the effect of technology on the mathematics learning of Saudi primary grade students with mathematics difficulties. However, observation may not have been enough because he wanted to investigate the teachers' usage of technology with those students, and their perceptions about using it, and for these objectives, conducting face-to-face interviews would probably have been the best approach. The study found evidence to suggest that there were positive effects to using technology on the mathematics learning of Saudi primary grade students with mathematics difficulties. These include technologies that can give meanings to numbers, which can remove any necessary barriers to further learning and can enhance the latent strengths of students with mathematics difficulties, thereby boosting their confidence; some technologies can help such students to remember what they have learned (because the brain can more easily understand and remember visual information).

Overall, when we questioned what is the effect of technology on mathematics education, we found many studies that have already addressed this issue, for instance, the studies conducted by [36, 35], all of whom examined the impact that technology has on learning mathematics. The results of those studies demonstrate that the use of technology increases motivation and self-efficacy in mathematics learning. Other studies, such as Bidaki and Mobasheri [2] have found that the role of technology is to save teaching time, and to discourage and minimize adverse outcomes for those students with difficulties in mathematics. In addition, Wilson et al. [39] found the Number Race software to be a powerful tool in mathematics, helping students to simplify their understanding of mathematical operations when more complex skills are required. Finally, a study by Alabdulaziz [1] found that the benefits of technology in the learning of mathematics are giving meanings to numbers, building student confidence and helping them remember something they had already learnt. These studies also indicated the significant positive effects of using technology such as the interactive whiteboard. The current study is consistent with all of the above studies in regard of the view that technology brings positive outcomes into the classroom. However, in this study we found something different from previous studies that the use of technology not only helps in increasing practice and motivation, but also we use it to support constructivist and radical constructivist approaches when helping students regarding their misconceptions about mathematics.

III. Methodology

A. Data Collection Method

This case study was conducted at two primary schools in Saudi Arabia, with three male mathematics teachers in school A, who use technology with their students who have mathematics difficulties, and three other teachers in school B do not use it with their students.

Each one of these six teachers were interviewed and asked general questions about the use of technology (Part 1). Each was then observed in their classrooms and, finally, every teacher was individually interviewed and asked specific questions to address the research questions (Part 2).

B. Data Analysis

Firstly, all interviews were recorded and transcribed verbatim after each session. The each transcript, interview data and observation notes were read and re-read. Secondly, thematic coding was used, underlining the text in different colors, and matched data in categories separately which allowed reduction and synthesis of large quantities of information. Thirdly, all the identified commonalities were divided into themes, and supported with quotes.

IV. Findings

We found that some of the first teacher's students had difficulties in multiplication concepts, which included failing to understand that any number multiplied by zero equals zero and understanding that multiplication does not always

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make bigger numbers. Their teacher used Mighty mathematics Number Heroes program through the IWB, which benefited from the great features offered by this tool to help students. As a result, during our 45 day observations, we noticed the positive effect of this tool on teaching and learning. This helped the teacher save the lesson through IWB, and open it at any time during the lessons when he needed it to connect the previous information to the new one, saving the teacher precious time. In regard to the students' learning, we found its effects on learning positive; this was evident when we saw the ability of this tool in shifting anxiety and depression among students of mathematics to a more motivational and active state. And particularly on learning multiplication concepts, we found it useful in building students' confidence.

It is interesting to mention in this section how technology can support a constructivist approach when teaching and learning mathematics. We can find the answer to this question through our findings in this study. For instance, some of the third teacher's students have difficulties with multiplication (e.g. some of them imagined that the concept of multiplication is the same role of the concept of addition in terms of dealing with zero, which they think that any number multiplied by zero does not equal zero. Some others when multiplying 500 by 232 they directly dealt with the zero as subtraction rule and for which they borrowed from the next number. In addition, two of the students took a long time to answer to the teacher for 10 − 7 or 8 − 4; sometimes one of them took a long time and answered wrongly such as 20 − 13 = 5, 10 − 7 = 6 and 8 − 4 = 5, which he answered with confidence). And we noticed that this teacher used Number Race software through the IWB to rebuild those students with addition and subtraction, and to be able to reach to the concept of multiplication without difficulty or misunderstanding through this strong construction. Actually, we noticed that IWB had greatly facilitated the dealing with this program in terms of turning on and off, using the teacher figure to highlight any important point to make it clear for the students. This teacher also used the camera to take both photos and videos of those students while using the program.

Indeed, the teacher further took all the pictures and videos from the first two weeks and added them to a PowerPoint presentation, to connect what students learned through The Number Race software and multiplication concepts. For example, when the teacher started to open the first presentation, we found that video clip and pictures embody the students' participation during the first day of their use of that program, and then the teacher started to connect this video on the introduction of the multiplication concepts and so on. Indeed, we noticed that the content and the goal differed from day to day. However, the general idea of this use is that the teacher tried to connect the dealing with zero in addition, subtraction and multiplication at all slides. As a result, the students overcame the difficulties they faced in multiplication concepts and moved from their face of misunderstanding. In addition, the final goal of these slides is to help those students to connect and remember what was learned in zero rule in addition and subtraction lessons and about zero rule in multiplication.

During all the presentations, we noticed that the teacher tried to make the most from the positive features provided by this program, for instance, inserting an image and video from file or insert clip art, slide transitions with simple animation effects such as fading slides in and out, background effects, visual effects such as shading and beveling. All these advantages made his presentations more clear and interesting for those students. Therefore, overall we can say that we noticed the positive impact of these tools (the IWB, Number Race software, the PowerPoint programme and the camera) on teaching and learning mathematics. In teaching, they gave the teacher a quick chance to identify the students' strengths and weaknesses, which made easy for him to build those students correctly, and in learning mathematics generally, they appeared to have a positive effect on students in terms of improving and boosting their recall, these tools were also able to enhance the students' confidence and did not hesitate while answering the teacher's questions.

Moving on to a radical constructivist approach, which looks at software that helps to use a different representation when teaching specific mathematics tasks, this helps students to make sense of the tasks. We can find this in the teaching method of teacher two, who tried to use the IWB with more creativity and innovation in subtraction lesson than the remaining lessons. Because some of his students have difficulties in subtraction which is divided into two parts. The first comprised some students who had difficulties when borrowing from zero in subtraction calculations, for example, when they have to subtract 352 from 500. The second is some others who avoid the first difficulty by starting from 5 − 3 and then 0 − 5 and 0 − 2 when they subtract 352 from 500, and the difficulty became more complex for them because they wanted to avoid dealing with the zero at the beginning of the task, and they made a mistake when they start to solve the task on the left side instead of right side. In addition, we noticed that when some of those students

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reach to solve 0 – 5 and 0 – 2, they answered 5 and 2, and some others stopped solving with a big question mark in their face.
Indeed, as we noticed that when the teacher used the IWB with subtraction lesson, he tried to use something interesting with more effort. For instance, two days before the lesson, the teacher asked six students who had begun to overcome the difficulty of understanding the concept of subtraction to represent and embody subtract 352 from 500 in which the teacher put on the body of each one of them a poster paper with the number written on it. The first student represented the first zero on the right, the second one represented the second zero, the third student for number five and so on. It is important to mention that the teacher put those students in the form of a real task so that under the student who represented the number zero on the right was the student who represented the number two, and then under the student with number second zero was the student with number five, and so on. Then the teacher asked one of the students who had difficulties in understanding subtraction to go to the first student who represented first zero and ask him can I subtract you on two and he answered no it does not work, please go to my neighbour and borrow from him and so on. Eventually, the student reached to the student who represented number five, and he answered yes you can borrow one and take it to the next door which is number zero and so on.
The teacher added some sound effects on this video through IWB beneficiary of the huge potential offered by this tool. For instance, when the student moved from number zero to the next zero, we heard knock sound and fantastic word appeared from IWB which gave more interaction and excitement between those students. As a result, we noticed three aspects of the effect of IWB on students; these include teaching by saving the teacher's time, in learning mathematics generally by overcoming the challenges that arose from these difficulties, and in learning the concept of subtraction particularly by drawing the students' attention that led them to like mathematics which resulted to overcome the difficulties they faced.
Based on the above, we can see clearly how technology can support constructivist and radical constructivist approaches when teaching and learning mathematics; and, in the next chapter, we will discuss both approaches further.

V. DISCUSSION

As we mentioned in the previous section, some of the third teacher's students had difficulties in the concept of multiplication. Some students failed to understand that any number multiplied by zero equals zero. In addition, two of the students found it difficult to deal with subtraction tasks such as 20 minus 13, for which they took a long time to answer, and answered it wrong. Therefore, their teacher decided to use a constructivist approach with his students through the Number Race software to rebuild those students with addition, subtraction and multiplication concepts and to be able to reach to the concept of multiplication without difficulty or misunderstanding through this strong construction.
Actually, we noticed that technology supported and facilitated the implementation of the constructivist approach. Also we can see the positive impact of this tool and the constructivist approach on teaching and learning mathematics. This included identifying students' strengths and weaknesses. It is important to mention that this effect was considered as a great positive impact on this teacher because two of the mathematics teachers in school B who did not use technology with their students reported to me that it was difficult to recognize the weaknesses of their students easily; as usually the students who had difficulties in mathematics felt embarrassed to raise their hands up in front of their friends to participate in answer any question that was asked by the teacher or if this student had any question to ask the teacher. This embarrassment led to accumulation of all the difficulties and misunderstandings in the students, which resulted to aggravation and continue of the difficulty in the next years of school. All these were because of the type of teaching method that made these difficulties to continue with those students without being discovered and solved.
Moving to the effects of this tool on learning mathematics, we noticed that it helped those students in enhanced confidence and did not hesitate while answering the question. In addition, it also appeared to have a positive effect on students in terms of improving and boosting their recall. For example, at the beginning of each lesson, the teacher did a quick review on the previous lesson, to ensure that the students understood the previous lesson well. This led him to build the new lesson on the previous lesson directly. The point that we wanted to reach is that we noticed that all the students remembered the previous lesson and recalled the information easily, because when this teacher used IWB and tried to create a picture in the students' mind which made connections between the picture and mathematics tasks which resulted for students to remember the answer of tasks easily.

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Turning to teacher two who tried to use the IWB with more creativity and innovation in subtraction lesson than the remaining lessons, which led him to use different representation for teaching very specific aspects. Because some of his students did not understand how to borrow from zero in subtraction calculations. Therefore, the teacher asked six students to represent and embody subtract 352 from 500 in which the teacher put on the body of each one of them a poster paper with the number written on it. During this presentation the teacher started to record video by camera, and then he added some sound effects on this video through IWB beneficiary of the huge potential offered by this tool. This method drew the students' attention that led them to like mathematics which resulted to overcome the difficulties they faced.

Based on the previous section and the discussion above, we can conclude that teachers one and three used technology for more motivation, different practice and explanation, while teacher two tried to use a different representation to teach the students very specific aspects of mathematics, such as borrowing from zero in subtraction calculations. In addition, we can conclude that the ways in which teachers one and three used technology to help their students with misconception are more consistent with the literature on the constructivist approach to mathematics teaching. However, they may not always be the solution for a specific misconception; we sometimes need a representation to overcome a misconception directly. It is also interesting to mention that the use of technology not only helps in increasing practice and motivation, but also we use it to support constructivist and radical constructivist approaches when helping students regarding their misconceptions about mathematics.

VI. Conclusion

The paper aimed to investigate the relationship between technology use and implementing constructivist strategies when teaching Saudi primary students' mathematics difficulties. Semi-structured interviews and observations were used for the purpose of this research, which were undertaken with three mathematics teachers from school A which used technology, and the other three from school B, which did not use technology. We found that technology can support constructivist approach when teaching and learning mathematics. Therefore, it is interesting to mention that the use of technology not only helps in increasing practice and motivation, but also we use it to support constructivist and radical constructivist approaches when helping students regarding their misconceptions about mathematics.

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Appendix 20

The codes for all my interviews

Key:

T1	Teacher one
T2	Teacher two
T3	Teacher three
T4	Teacher four
T5	Teacher five
T6	Teacher six
T1,2,3	Teacher one, two and three
T4,5,6	Teacher four and five and six
T1,2,3,4,5,6	All six teachers

Example from teachers' interviews	Codes	Theme
Yes, because the increase in technology nowadays should be exploited by teachers to benefit students, and we do not have to ignore it. Therefore, we have to continue to keep up with the skills required for technological change that lead to get the most of the advantage of the use of technology in the classroom.	T1: He wanted to take advantage of the rapid development of utilising technology for teaching students.	1- Teaching approaches
Yes, for the reason that my students struggle with mathematics; this has prompted me to try a myriad of strategies in a bid to simplify this task. In these endeavors, I realized that the use of technology is an excellent way of making mathematics seem more entertaining and less intricate, which lead the students to be more enthusiastic about learning mathematics.	T2: He found that teaching with IWB made the subject more entertaining and less complex to grasp.	
Yes, I made the decision to draw on the technology when educating my students because technology has grown to be a fundamental part of our daily life and students have an outside classroom experience with technology. By integrating the use of technology education, it is possible to engage students' interest in a subject and as a result, they will be able to receive more information during learning mathematics.	T3: When using these technologies inside the school would engage students' interest in learning mathematics.	
From the previous responses of the	T1,2,3: All three mathematics	

teachers, I find that all three mathematics teachers agreed that technology helped them cover the all key mathematical concepts in the syllabus	teachers agreed that technology helped them cover the all key mathematical concepts in the syllabus.	
I asked each teacher, why they chose especially this technology which Interactive Whiteboard, when they decided to attend a training course. T1 answered: *I choose this because the electronic interactive whiteboard is a device that combines a variety of uses which can be adapted for use with all lessons in mathematics and all levels at primary school.*	T1,2,3: All three mathematics attended a course to take advantage of all the advantages of smart board use and how to use it with the students who suffer from mathematics.	
T2: To be successful and significant, the use of technology must become part of the everyday practices. To help those new mathematics teachers to use technology regular routine in the classroom, they have to know that students must be made very clear that using computers, interactive whiteboards and other tools and software are not some sort of reward or special event that has to be earned by them. In fact, students must see technology similar to other equipments of learning for example textbooks, pencils.	T1,2,3: They used IWB every day with their students.	
I asked him how do they address this misconception? He mentioned that this can only be possible if those teachers changed their view of technology to be seen as a supplement rather than a substitution of ideal teaching as a practice.	T1: When the technology is perceived as supplemental to teaching practice rather than as a replacement, it is more acceptable to others.	
T2: To be successful and significant, the use of technology must become part of the everyday practices……..	T2: The use of technology must become an integral part of everyday practice.	
……… *because I believe that teaching mathematics with technology is very important.*	T3: Teaching mathematics with technology is very important.	
T4*: …..Now, since I have no idea how to use technology in class for mathematics lessons, and, thus, I have*	T4,5,6: Although they knew the positive impact of IWB on teaching and learning on students who have	

not tried to surmount this obstacle, because I need more encouragement in place in order to receive the required *training and thereby demonstrate innovative teaching. As such, I did not decide to use technology, although I understand the positive impact of IWB on learning amongst students who have difficulties in mathematics. As a result, I might change my mind if there is support and encourage the use of technology……* T5: *….. I believe that interactive whiteboard has a significant impact on students, especially those dealing with the difficulties of mathematics….*	difficulties in mathematics, they did not use it with their students.	
The function of interactive whiteboard in mathematics education is to boost the motivation and aptitude of students who experience difficulties in working mathematical problems.	T1: Draws the attention of students and boosts their motivation and aptitude in learning mathematics.	2- The effect of technology on students who have mathematics difficulties
The importance of early intervention with those students who have difficulty learning mathematics with the involvement of technology in this intervention, will benefit the students by reducing and eliminating the adverse results for students who experience mathematical difficulties, because this tool will make this subject more easy and entertaining.	T2: Facilitate learning mathematics and for entertaining and engaging students.	

In order to determine changes in confidence toward mathematics and the improvement in the students' memory as a result of IWB intervention at the previous year, I tried to notice the effects of IWB on students, with a focus on enhancing confidence in mathematics and help children who struggle with working memory and mathematics. I also tried to apply that experience with these students in this year and found that the IWB approach lead to realization of substantial improvements on their memory and confidence in mathematics. I will show you your note during the classroom time that is, how this experiment works with those students to see that technology's role the education of mathematics is to give meanings to numbers, to enhance students' confidence and to aid in boosting the memory of the students.	T3: Enhance confidence in mathematics and the improvement in the students' memory.	
T4: ……*although I understand the positive impact of IWB on learning amongst students who have difficulties in mathematics. As a result, I might change my mind if there is support and encourage the use of technology.* T5: ….. *I believe that interactive whiteboard has a significant impact on students, especially those dealing with the difficulties of mathematics….*	T4,5: They believed that technology had positive impacts on students who experienced difficulties in learning mathematics.	
The first is to enhance the teaching quality through improving the interaction, communication and collaboration levels; moreover, encouraging learning by increasing motivation and readiness of students to solve mathematical problems.	T6: The first is to enhance the teaching quality through improving the interaction, communication and collaboration levels; moreover, encouraging learning by increasing motivation and readiness of students to solve mathematical problems.	
Although schools may have IWB available, one factor that influences teachers' decision of using it is where those IWB are located……	T1: The school was behind the decision not to use technology.	3- The challenges faced with the use of technology
Teacher's negative attitudes towards	T2: The teachers themselves and the	

computers affect their decision of the using it in classroom……. He added: *In regard to school, the school administrator plays an important role in the teacher's decision to use technology…….*	school.	
I would like to explain why I chose school only and not the teachers. Because some people criticize teachers only, that he/she is the only reason behind not using technology in his class……	T3: The school.	
The school only.	T4, 5, 6: The school only	
According to teacher one, he thinks the major obstacle facing teachers when using technology with those students who have mathematics, is dependent primarily on the attitude of teachers towards the use of technology and that this determines the level to which technologies are to be applied in teaching and learning processes.	T1: The major obstacle facing mathematics teachers when using IWB with their students is the teacher attitudes and beliefs about teaching mathematics with technology.	
T2 gave me a clear picture that the major obstacle facing mathematics teachers when using IWB with their students is the lack of training.	T2: Training teachers to use technology.	
T3 believes that the major obstacle facing teachers when using technology with those students who have mathematics difficulties is the lack of technical support.	T3: Technical support.	
T4: *As you know that I do not use technology in this school at all, but I can answer your question from my experience in this school. I found that the attitudes of the head teacher are directly related to the availability of technology and the use of it in the classroom….*	T4, 5, 6: Head teacher attitudes and beliefs about teaching mathematics with technology.	
All six teachers agreed that the head teacher is the only person who can initiate the necessary teacher training.	T1, 2, 3,4,5,6: all six teachers agreed that the head teacher is the only person who can initiate the necessary teacher training.	
These teachers said that the school director was allocated a part of the budget to help them when they need	T1,2,3: All three teachers in school A agreed that their head teacher had a positive tangible impact on	

support for technical emergency.	overcoming the obstacle of technical reforms.	
T2: *If we need to help teachers to overcome the negative attitude towards the use of technology training, we should provide appropriate training for them, not only with opportunities to explore new technologies but also practical ways to obtain support and guidance in using them.* T3: *The teachers should also have trainers who train them through active participation instead of just giving verbal information of what should be done.*	T2,3: We should provide appropriate training to overcome the negative attitudes of teachers towards the use of technology.	
In my opinion, I will ask this teacher to attend a lesson with a teacher who uses technology, in order to see the positive impact of technology on students himself.	T1: Teacher one added that he would like to invite those teachers with a negative attitude towards technology to see for themselves the positive impact of technology through attending a lesson with another teacher who uses technology.	
All three teachers tried to discuss the importance of the use of technology in mathematics, particularly with students who have difficulties with mathematics. Therefore, they think that if the teachers discuss their need of technology and show the advantages of using it, this may help them to change head teachers' attitudes	T4,5,6: If the teachers discuss their need of technology and show them the advantages of the use it, this may help teachers to change head teachers' attitude.	
Teacher one pointed out that multiplication facts and skills are imparted on students in the third grade but each year, a number of students enter sixth grade having not learned these facts	T1: Multiplication.	4- Mathematics difficulties
My students have difficulty subtraction because of three reasons…	T2: Subtraction.	
I utilized the Number Race program and PowerPoint presentation through Interactive Whiteboards to conduct this lesson (multiplication facts)……	T3: Multiplication.	
-	T4: Subtraction.	

-	T5: Multiplication.	
-	T6: Multiplication.	

Appendix 21

The codes for all my observations

Key:

T1	Teacher one
T2	Teacher two
T3	Teacher three
T4	Teacher four
T5	Teacher five
T6	Teacher six
T1,2,3	Teacher one, two and three
T4,5,6	Teacher four and five and six
T1,2,3,4,5,6	All six teachers

Codes	Theme
T1: Teaching with technology.	1- Teaching approaches
T2: Teaching with technology.	
T3: Teaching with technology.	
T4: Traditional method.	
T5: Traditional method.	
T6: He had previous experience with technology before and wanted to transfer it to benefit from its positive results. However, he used his laptop and the projector for only a week.	
T1: With regard to teaching, this appeared when the teacher used the save feature of the lesson to be opened at any time, later. o With reference to learning mathematics, generally, the use of IWB was able to shift the negative attitudes of students to a more motivated and active attitude. o In facility mathematics difficulties, it was able to build mathematics confidence in a fun and interactive way.	2- The effect of technology on students who have mathematics difficulties
T2: With regard to teaching, the IWB was able to save the teacher's time in the classroom. o In learning mathematics, generally, this tool enabled the reduction of negative results that arise from these difficulties. o In facility mathematics difficulties, showed the speed of response of students to overcome the difficulty.	
o T3: It helped identify the students' strengths and weaknesses. o It helped improve and boost their working memories. It enhanced their confidence and the students did not hesitate while answering the questions	
o T4: There was wastage of the class time, without the main objective of the lesson being completed. o With regard to learning mathematics in general, this	

method does not provide incentives and enthusiasm to ease the difficulty of mathematics. o In facility mathematics difficulties, this method was unable to guide the students in the correct way, which resulted in the exacerbation of the difficulty instead of overcoming it	
T5: Most students did not want to participate since this method did not stimulate them to raise their hand to interact with the teacher. o This method contributed to distract students' attention, as a result of which they found it difficult to understand the next lesson. o It was difficult for this teacher to help the students overcome difficulties, since he was unable to provide a lesson in a stimulating and entertaining way with this method.	
T6: During his usage of these tools, I noticed that this method saved class time, which allowed the students to practice with more examples. As a result, they could easily remember their lessons and this increased their self-confidence. o On the contrary, after his usage of these tools, I found the opposite of the above point. This led them to not remembering their lessons, and there was a decrease in their self-confidence.	
T1,2,3: It is interesting to mention that all these three teachers did not find any challenges during their use of this tool, and this could also be because of the positive effect that the school's head teacher had on them.	3- The challenges faced with the use of technology
T4,5,6: I noted that the attitude of the head teachers towards IWB reflected on them in the provision and use of IWB within the classroom	
T1: Some students failed to understand that any number multiplied by zero equals zero. o The students found it difficult to understand that multiplication does not always make results bigger.	4- Mathematics difficulties
T2: Some students did not understand how to borrow from zero in subtraction calculations.	
T3: Some students failed to understand that any number multiplied by zero equals zero. o Two students found it difficult to deal with subtraction tasks such as 20 minus 13, for which they took a long time to answer, and answered it wrong.	
T4: Borrowing from zero in subtraction calculations.	
T5: Understanding that any number multiplied by zero equals zero.	
T6: Understanding that any number multiplied by zero equals zero.	

Appendix 22

Transcription of Teacher's Interview
Teacher one
English Translation

Researcher: Thank you for accepting to take part in my study. We will start with the general questions about the use of technology (Part 1).

Teacher one: *Ok, no problem.*

Researcher: Umm…

Researcher: Before asking you the first question…. Umm… I would like to ask you the following question….

Teacher one: Ok…. with pleasure.

Researcher: What is the meaning of technology for you?

Teacher one: *Some people always think that technology means computer only. However, technology is more than computers; it means the computers just a type of technology. As a result, the meaning of technology to me is a set of appropriate tools which **include computers**, IWB, TV,* video *and projector meant to enhance teaching practices and improve learning outcomes.*

Researcher: Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology?

Teacher one: *Ya…Yes, because the increase in technology nowadays should be exploited by teachers to benefit students, and we do not have to ignore it. Therefore, we have to continue to keep up with the skills required for technological change that lead to get the most of the advantage of the use of technology in the classroom.*

Researcher: What are the types of technology you use with those students? Why do you use those items?

Teacher one: Uhum... could you please say again.

Researcher: Ok no problem**.**

Researcher: What are the types of technology you use with those students? Why do you use those items?

Teacher one: *I have used an interactive whiteboard. First of all I would like to give the reader what I mean by Interactive whiteboards? How does it work? What does it* *do? Why I use it? Is how I use the board in my lessons more important? An interactive whiteboard is an instructional tool that is connected to a computer and projector, which consisting of a large touch-sensitive that allows the teacher manipulate the elements on the board through the use of either special pens or fingertips directly on the screen, this is utilized instead of the mouse. I have been using the electronic interactive whiteboard for two reasons. The first reason is that I know the effect of interactive whiteboard technology on students who have difficulties in mathematics. Therefore, I became interested to use this tool in helping my students overcome the difficulties they have in mathematics. Secondly, the device combines many features and characteristics in one tool. These includes: displaying all sorts of information in an interesting format, with the ability to interact with the information that is being shown such as highlight text to draw attention to specific parts of a lesson, I can easily record the lesson by saving and reopen it to the students who were absent from a lesson to review or re-explain the lessons missed. In addition, it shows pictures and educational videos of which I can pause at a certain point for discussion and brainstorming*.

Researcher: Does the technology help you cover the key mathematics concepts in the syllabus?

Teacher one: Yes (and he pointed out that after the development of mathematics curriculum by the Ministry of Education, technology has become an integral part of the curriculum. In addition, the King Abdullah Bin Abdulaziz Public Education Development Project (Tatweer) purposes to improve results of education in the Saudi Kingdom via enhancing the use of technology. There are broader education reforms in Saudi Arabia, and this project is one of its parts, which also lead to elevate the position of the Saudi Arabia between developed countries in education).

Teacher one: *I would like to give the reader a clear picture of the King Abdullah Bin Abdulaziz Public Education Development Project (Tatweer), it is a Saudi based company which offers educational services. It works with the Ministry of Education to develop the educational system, focusing on areas such as the development of Science, Technology, Engineering, Mathematics, Computer Education, Arabic and the English language teaching program.*

Researcher: Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?

Teacher one: *The function of interactive whiteboard in mathematics education is to boost the motivation and aptitude of students who experience difficulties in working mathematical problems.*

Researcher: Could you please give me evidence to support the point.

Teacher one: (He showed me the students' report before the use of the IWB and after using it which shows that their grades have increased upon the use of such technology.

The results from the report contribute to the belief that the use of IWB attracts students to be continually interested in the lesson).

Teacher one: *I can also prove to readers that the IWB had a positive influence on student's motivation to learn new concept of mathematics, when I started my work as teacher at one of the primary schools there was not technology available in the school I taught in, where I had a class consisting of 20 students and some of them had difficulties in learning mathematics. At that time I used traditional methods to teach them mathematics. This means without technology. When the Ministry of Education began to integrate the IWB into schools, I learnt the basics of using this tool and tried to use it with my students. Indeed, I noticed improvements in the students' motivation after using the IWB.*

Researcher: Have you learnt anything new by using technology in your class?

Teacher ne: He learnt how he uses interactive Whiteboard with students who struggle with mathematics, where this course takes place inside the school. The main goal for taking this course was to ensure that he is able to exploit all of the features of interactive whiteboard technology during use with those students who have difficulties in mathematics, which was taught by qualified and experienced teachers and trainers. When he finished a training session which lasted about two days, he was given a certificate showing that he has successfully completed this course.

Researcher: Why you chose especially this technology which Interactive Whiteboard, when you decided to attend a training course?

Teacher ne: *I choose this because the electronic interactive whiteboard is a device that combines a variety of uses which can be adapted for use with all lessons in mathematics and all levels at primary school.*

Researcher: What are the main reasons behind the decision of the mathematics teacher to not use technology to help students with mathematics difficulties? (Teachers themselves, school, government).

Teacher ne: *Although schools may have IWB available, one factor that influences teachers' decision of using it is where those IWB are located. In other words, keeping the IWB in one place in school will hinder and prevent constant use by the teacher. As a result, teacher may make a decision to leave this tool as the availability will be limited and then students don't benefit greatly from technology as the teacher will not cover all the areas of mathematics with technology.*

Researcher: Does all schools have a limited number of technologies despite the Ministry of Education in the Kingdom being keen on the distribution of technology to schools, which are supported by the Saudi government continuously.

Teacher ne: Yeah… yeah…

Teacher ne: *I think you asked me a good question, and I would like to be clear. The Ministry of Education distributes smart boards gradually in schools, and then if there is any lack of IWB in any school, the school principal has to write a report on the amount of interactive blackboards they need in their school.*

Researcher: What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of (Training teachers to use technology? Technical support? Teacher attitudes and beliefs about teaching mathematics with technology?

Teacher ne: (According to teacher one, he thinks the major obstacle facing teachers when using technology with those students who have mathematics, is dependent primarily on the attitude of teachers towards the use of technology and that this determines the level to which technologies are to be applied in teaching and learning processes).

Teacher ne: (He believes that if teachers have a positive attitude regarding the use of the Interactive Whiteboard for the aims of education, then they will use it in class. However, if teachers have a negative attitude regarding the use of IWB, such as believing that the Interactive Whiteboard does not encourage teachers to use discussion methods with their students, which leads to lack of collaborative exchange of ideas among a teacher and students. In addition, some others may believe that the lack of time during class does not allow them to use technology effectively. Moreover, some may believe that there is no technology available when they study at University. As a result, they will prefer to teach their students without technology, as they have no idea about technology. This indicates that there is a relationship between the use of IWB and the attitudes among teachers).

Researcher: Do you need any further support to use technology, and if so, what support do you need?

Teacher ne: (He felt no need for any further support to use technology, because the principals of his school encourage him to overcome any obstacles he face during his use of IWBs. He agrees that the availability of technology in schools is no longer the issue in education in the Kingdom of Saudi Arabia, as the ministry of Saudi has a great financial support from government to provide the necessary technology in schools. However, the current emphasis lies in ensuring that teachers can use this technology as an effectively way in teaching. As a result, this need simply leads to training teachers to keep up to date with all new technologies to promote learning for all students in the classroom.

Researcher: Thank you very much.

Teacher ne: *You're welcome.*

Researcher: Thank you again for accepting to take part in my study. We will move to the specific questions to address the research questions (Part 2).

Researcher: Why did you decide to use/not use technology for this lesson with students who have mathematics difficulties?

Teacher one: (Teacher one pointed out that multiplication facts and skills are imparted on students in the third grade but each year, a number of students enter sixth grade having not learned these facts. This has leads to the students' lack of the fluency required in the learning the more intricate mathematical concepts in the mathematics curriculum during the sixth grade. An example of a multiplication fact learned in the third grade is that multiplying any number by zero equals zero. He added:

Teacher one: *I however observed that some students in the sixth grade were not familiar with this concept and, I think one of the reasons why they may not learn multiplication in a more interesting way is that by not using technology may lead them not to remember this concept. I always use technology with lessons. However, I am more and more keen to use technology in this lesson, particularly to ensure students do not continue to lag behind in mathematics throughout middle school.*

Researcher: Is technology used to increase basic skills, to make the understanding of complex mathematical operations easier or as a resource to entertain students?

Teacher one: Umm… Both.

Teacher one: *As we know mathematics difficult for some students in this school. However, it has important applications and many uses in life such as reading an odometer, doing business, counting change and many others. Therefore, engaging students through entertainment technology to make the understanding of complex mathematical operations easier will help those students to look at mathematics as an easy subject, and then help them deal with the numbers in the future. As a result, I used IWB for increasing fundamental skills, to make difficult mathematical operations simpler as well using it as a resource for entertaining students.*

Researcher: How often do you use technology when teaching students with mathematics difficulties?

Teacher one: Umm… *Every single lesson.*

Teacher one: *I know that in this school the teachers who have started using technological tools in their daily routine have a common concern and that is the time needed for planning and incorporating these tools in their daily lessons. Teachers believe that in adopting such equipment, much of their existing lesson plans have to be rewritten, however, these beliefs are but misconceptions.*

Researcher: How do they address this misconception?

Teacher one: (He mentioned that this can only be possible if those teachers changed their view of technology to be seen as a supplement rather than a substitution of ideal teaching as a practice).

Researcher: Where do you usually get your ideas from for using technology? (Magazines, colleagues, workshops, technology coordinator, Internet, etc.)

Teacher one: *By myself.*

Teacher one: *Variety is the spice of life and every good teacher knows that you have to use a different set of ideas and use it with technology to help all the different individual needs of students. I usually use brainstorming as a tool to find out appropriate ideas that can be used with Interactive Whiteboard to help students who have difficulties in mathematics by fulfilling the requirement of the students, which includes assessing prior knowledge and increasing the learning rate.*

Researcher: Did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe? If not, how did you overcome the problem of training?

Teacher one: *The answer is yes, however, it is not enough for me, therefore, I overcame the problem of training, through attending various training courses including 'The Use of Technology in Mathematics Education', 'Towards Technology Integration in Mathematics Education', and 'The role of Technology in Teaching and Learning Mathematics'. All those courses took place at different periods of school time.*

Researcher: If offered, how likely would you be to participate in technology training either during or after school time?

Teacher one: *I am extremely likely to participate in this session and I will also encourage all my colleagues to be present: because in developing the understanding of the technology and its value the teachers must derive knowledge from continuing learning opportunities. As the technology advances, they must realize that it would benefit them personally and professionally. Teachers must obtain the various advantages that the technology offers not only for them but also for our students' learning and for their futures.*

Researcher: With regard to the next question of my interview questions, "If no, what factors may have led you to not attend training sessions?" I will not ask you this question because this question seemed to be based on your answers to the previous question where the answer was yes.

Researcher: What is needed to make the necessary teacher training work?

Teacher one: *Although mathematics teachers of which I am one in this school with many years' experience, we know the role of technology or to be more specific Interactive Whiteboard on mathematics education and understand the importance of* *training sessions. But in all honesty, our head teacher has the positive effect to make the necessary teacher training work in this school. Therefore, I will answer your question by saying, head teachers are ultimately responsible for making the necessary teacher training work, by using incentives to motivate teachers, and follow-up of new technology as incorporated in the classroom. Generally, the large proportion of the head teacher's duties include effective administration and regulation of the school to create an optimum learning environment.*

Researcher: If you wanted a technical support in your class but it is not available in the school right now, how would you overcome this problem?

Teacher one: (He said that usually the system here in Saudi Arabia through the Ministry of Education gives each school principal a budget for the operation of the school; and the amount of budget depends on the type and size of school. All school principal use this budget by the school needs to ensure they motivate teachers and students to continue education as required).

Teacher one: (Return to the answer to question above, this teachers said that the school director was allocated a part of the budget to help them when they need support for technical emergency.

Teacher one: (The head teacher has mastered the disposition of the use the budget made them unique, as he ensured they did not hear this term at all "it is not available in the school''. This head teacher tries to remove the obstacles in front of teachers' in order to help them to continue using technology without stopping as he said).

Researcher: How can we overcome the negative attitude of teachers towards the use of technology?

Teacher one: Umm…

Teacher one: *In my opinion, I will ask this teacher to attend a lesson with a teacher who uses technology, in order to see the positive impact of technology on students himself.*

Researcher: Do you have any questions? Or comments or anything you would like to add.

Teacher ne: Thanks

Researcher: Thank you very much.

Teacher ne: *You're welcome.*

Transcription of Teacher's Interview
Teacher two
English Translation

Researcher: Thank you for accepting to take part in my study. We will start with the general questions about the use of technology (Part 1).

Teacher two: No problem.

Researcher: What is the meaning of technology for you?

Teacher two: Umm…

Teacher two: *I think this is a good question and thank you for asking me this question; I will answer this question as follow; the meaning of technology in education is development, design and application of tools and techniques to improve both teaching and learning mathematics. The word of tools as mentioned here is Interactive whiteboard, computer and projector.*

Researcher: Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology?

Teacher two: *Yes, for the reason that my students struggle with mathematics; this has prompted me to try a myriad of strategies in a bid to simplify this task. In these endeavors, I realized that the use of technology is an excellent way of making mathematics seem more entertaining and less intricate, which lead the students to be more enthusiastic about learning mathematics.*

Teacher two: *Moreover, Saudi's national public education system curriculum has been overhauled leading to immense changes in the last few years. Due to these changes, I have been compelled to indulge into the use technology in the education process to facilitate dealing with the curriculum effectively and to deliver the information to students in a simple way.*

Researcher: What are the types of technology you use with those students? Why do you use those items?

Teacher two: *I used IWB with my students, and as I know you will observe me in my class to see and know more concerning how I use the Interactive whiteboards in my lessons. However, if you as ask me what is IWB and why I chose it, I can say that the IWB is a tool with a computer interface, it helps to display the images on the computer over the Board. Basically, computer, projector and an interactive board are the three main components of the IWBs system. If the computer and the data projector are not available, the IWB could not be used. These two systems are connected to each other through two cables. The first cable connects the projector and the computer, while the*

Board and the computer are connected by the second, which is the series cable. The reasons of using this tool is because an IWB provides multimedia presentations, several visualizations, which we can use all benefit from and more in classroom environments where mathematics is taught, in order to develop particular concepts and also enhance overall knowledge of the subject.

Researcher: Does the technology help you cover the key mathematics concepts in the syllabus?

Teacher Two: Yes (and he pointed out that after the development of mathematics curriculum by the Ministry of Education, technology has become an integral part of the curriculum. In addition, the King Abdullah Bin Abdulaziz Public Education Development Project (Tatweer) purposes to improve results of education in the Saudi Kingdom via enhancing the use of technology. There are broader education reforms in Saudi Arabia, and this project is one of its parts, which also lead to elevate the position of the Saudi Arabia between developed countries in education).

Teacher Two: he pointed out that before development of mathematics curriculum by the Ministry of Education, it was difficult for him to cover the all mathematics topics in the syllabus through the use of technology in the structure of some topics at the pervious mathematics curriculum as, it did not help him find appropriate ways to present the lesson by using technology. However, after development of curriculum, he can take advantage of technology with those students who have difficulties, as the way of structuring the lesson is changed to include technology as an integral part.

Researcher: Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?

Teacher Two: (Teacher two mentioned to me before answering the above question that he preferred to move with his students from year one to year six. Because he believed that the first six years of a student life in school are a particularly sensitive period in learning and teaching mathematics. Therefore, when he is teaching these students from the first stage of education to the sixth stage, it will give him the opportunity for early intervention using the interactive whiteboard to avoid the persistence of negative results in the coming years. For example, he taught these students from year one to current year in year four. He added:

Teacher Two: *To answer your question, I will link the effect of early intervention with how IWB can help learners to learn mathematics, through this example. Some of my students faced mathematics anxiety when they were at year one that can impaired their development in mathematics. I asked those students individual the reasons behind their anxiety, which appeared to me that some of them were punished by their parents for failing to master a mathematical concept or being embarrassed in front of a sibling when failing to correctly complete a mathematics problem. And some others mentioned that before they begun the school, their family warning them of mathematics in terms of* *the difficulty and need to give more effort in order to succeed, this led to increased concern of mathematics and resulted to failure in mathematics.*

Teacher Two: *The importance of early intervention with those students who have difficulty learning mathematics with the involvement of technology in this intervention, will benefit the students by reducing and eliminating the adverse results for students who experience mathematical difficulties, because this tool will make this subject more easy and entertaining.*

Researcher: Have you learnt anything new by using technology in your class?

Teacher two: He learnt how he uses interactive Whiteboard with students who struggle with mathematics, where this course takes place inside the school. The main goal for taking this course was to ensure that he is able to exploit all of the features of interactive whiteboard technology during use with those students who have difficulties in mathematics, which was taught by qualified and experienced teachers and trainers. When he finished a training session which lasted about two days, he was given a certificate showing that he has successfully completed this course.

Researcher: Why you chose especially this technology which Interactive Whiteboard, when you decided to attend a training course?

Teacher two: Umm…

Teacher two: *Interactive whiteboards are an increasingly popular choice in primary schools in Saudi Arabia, and most mathematics teachers use them for different purposes. As a result, I only have this technology in my classroom; I want to ensure that I gain the most out of the technology.*

Researcher: What are the main reasons behind the decision of the mathematics teacher to not use technology to help students with mathematics difficulties? (Teachers themselves, school, government).

Teacher two*: I think teachers themselves and school.*

Researcher: what do you mean by teacher themselves and school?

Teacher two: *Teacher's negative attitudes towards computers affect their decision of the using it in classroom. For example, when some mathematics teachers initiate computer activities in their classroom and feel low confidence level during the use in front of their students. This feeling led to anxiety towards the use of computer, which often results in negative attitudes. At the end, the negative attitudes influence the decision of the mathematics teacher to not use technology to help students with mathematics difficulties.* He added:

Teacher two: *In regard to school, the school administrator plays an important role in the teacher's decision to use technology. For instance, if the teachers not getting any encouragement and support for using technology from the leaders.This cannot help* *them ensure that the use of technology is prioritized. As a result, teachers will feel uncomfortable in trying to use the technology, and then influence the decisions of teachers.*

Researcher: What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of (Training teachers to use technology? Technical support? Teacher attitudes and beliefs about teaching mathematics with technology?

Teacher two: (Teacher two gave me a clear picture that the major obstacle facing mathematics teachers when using IWB with their students is the lack of training. Clearly, IWB will not boost studying mathematics except for the teachers who are trained as to the suitable use of the technology. Consequently, teachers who have been trained effectively in the use of technology, and have enough expertise and skills in the utilization of computers, will have a positive impact on their students' progress. He also mentioned that this school has few teachers who during their studies at University were not trained to apply IWB in the classroom, but as those teachers understand that for students with learning problems using IWB can very effective, hence they try using technology for teaching their students).

Teacher two: (He also mentioned that when he was at a previous school, he found one of the teachers who was inexperienced with technology and lacked sufficient knowledge on how to set up technological devices. This led to constant interruptions during the lesson, and resulted in discomfort with using technology for teaching and learning. This clearly shows the key function tutors have in enhancing the operation and efficiency of technology after undergoing the necessary tutoring).

Researcher: Do you need any further support to use technology, and if so, what support do you need?

Teacher two: (He felt no need for any further support to use technology, because the principals of his school encourage him to overcome any obstacles he face during his use of IWBs. He agrees that the availability of technology in schools is no longer the issue in education in the Kingdom of Saudi Arabia, as the ministry of Saudi has a great financial support from government to provide the necessary technology in schools. However, the current emphasis lies in ensuring that teachers can use this technology as an effectively way in teaching. As a result, this need simply leads to training teachers to keep up to date with all new technologies to promote learning for all students in the classroom.

Researcher: Thank you very much.

Teacher two: *You're welcome.*

Researcher: Thank you again for accepting to take part in my study. We will move to the specific questions to address the research questions (Part 2).

Researcher: Why did you decide to use/not use technology for this lesson with students who have mathematics difficulties?

Teacher two: *My students have difficulty subtraction because of three reasons. First, they have the problem because of the misconception of over generalization from addition. Secondly, they fail to understand place value and, finally, they use faulty procedures when solving subtraction problems. However, the problem can be solved by IWB because it improves the student's comprehension. IWB helps students to connect with new information, make use of their previous knowledge make conclusions and create interpretations of the texts which in turn improve comprehension capability.*

Researcher: Is technology used to increase basic skills, to make the understanding of complex mathematical operations easier or as a resource to entertain students?

Teacher two: (Teacher two mentioned that he used IWB to simultaneously make learning entertaining and foster the comprehension of complex operations in mathematics. Because the students in primary school cannot learn mathematics without fun). He added:

Teacher two: *I was surprised when my colleague told me in the previous school that he only uses technology to entertain the students without access to the objectives of the lesson causing this teacher to stop the use of technology with his students. This is because he felt that the use did not improve the performance of students in mathematics. Then, I met with the teacher to ask him if he wanted to continue using technology in the right way, he should use technology for both reasons. This means that he can use fun technology to reach the lesson goals. Because, when the students see the technology in class, they know that it is for entertainment. However, the role of an ideal teacher will appear, when the teacher uses this technology to simplify the mathematics tasks.*

Researcher: How often do you use technology when teaching students with mathematics difficulties?

Teacher two: Umm …

Teacher two: Daily.

Researcher: How we can help new mathematics teachers use technology with their students every day lessons.

Teacher two: *To be successful and significant, the use of technology must become part of the everyday practices. To help those new mathematics teachers to use technology regular routine in the classroom, they have to know that students must be made very clear that using computers, interactive whiteboards and other tools and software are not some sort of reward or special event that has to be earned by them. In fact, students* *must see technology similar to other equipments of learning for example textbooks, pencils.*

Researcher: Where do you usually get your ideas from for using technology? (Magazines, colleagues, workshops, technology coordinator, Internet, etc.)

Teacher two: *Actually from myself and the internet.*

Teacher two: *I usually relied on myself to innovate new ideas by technology to serve these students to overcome the difficulties. However, sometimes I surf some sites in order to benefit from the experiences of mathematics teachers. There are many sites on mathematics education though technology does a good job in pulling together information from ideal mathematics teachers in this city. I benefited from these sites on two sides; the first includes the exchange of knowledge on how the tutors can enhance the system of learning to provide an ideal learning experience for the students. Secondly, sharing advice on the new ideas that can be used with technology to assist students with difficulties.*

Researcher: Did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe? If not, how did you overcome the problem of training?

Teacher two: *As you know, I attended various training courses that enabled me to understand the systems of computer at a deeper level and I was able to help students who faced difficulty in learning mathematics. Moreover, for gaining expertise in computing and the capability in solving difficult and challenging problems, I used every opportunity I received after school time. Thus, by learning new technology I not only was able to get a hike in my salary but also was able to help my students with mathematics by applying technology.*

Researcher: If offered, how likely would you be to participate in technology training either during or after school time?

Teacher two: *The teacher's primary role is to help students understand particular subject matter. Everything else is secondary. Therefore, with pleasure I will participate in technology training either during or after school time. I would like to know how computers improve the performance of a teacher and their work. What impact it will put on the core areas of the teacher's duties, to support the lesson objectives? How will they choose the most suitable technologies? How will these instructional goals be supported, by which technologies? For achieving the desired goals, how can technology be used with other learning tools? The focus of training program should not be only on the technology but also on the questions I just mentioned. If the training did not include these questions I will apologize for attendance because it will waste my time.*

Researcher: The next question of my interview questions, "If no, what factors may have led you to not attend training sessions?" I think you answer this question before, therefore, I will move to next question.

Researcher: What is needed to make the necessary teacher training work?

Teacher two: *The Ministry of Education ask all school head teachers to provide them with a comprehensive assessment of all teachers in his or her school, and this assessment of 100 degrees. The criteria for evaluating teachers often consists of quality of teaching, contribution to development and regular attendance in school. These standards directly affect the teachers in terms of promotion at Position and moving from school to school favored by the teacher. I think if the head teachers allocate a part of the teachers' evaluation degree to attending training without absence, they will make all the teachers keen to attend this training to earn big scores.*

Researcher: If you wanted a technical support in your class but it is not available in the school right now, how would you overcome this problem?

Teacher two: (He said that usually the system here in Saudi Arabia through the Ministry of Education gives each school principal a budget for the operation of the school; and the amount of budget depends on the type and size of school. All school principal use this budget by the school needs to ensure they motivate teachers and students to continue education as required).

Teacher two: (Return to the answer to question above, this teachers said that the school director was allocated a part of the budget to help them when they need support for technical emergency.

Teacher two: (The head teacher has mastered the disposition of the use the budget made them unique, as he ensured they did not hear this term at all "it is not available in the school''. This head teacher tries to remove the obstacles in front of teachers' in order to help them to continue using technology without stopping as he said).

Researcher: How can we overcome the negative attitude of teachers towards the use of technology?

Teacher two: *If we need to help teachers to overcome the negative attitude towards the use of technology training, we should provide appropriate training for them, not only with opportunities to explore new technologies but also practical ways to obtain support and guidance in using them.*

Researcher: Do have anything to add?

Teacher two: No.

Researcher: Thank you very much.

Teacher two: *You're welcome.*

Transcription of Teacher's Interview
Teacher three
English Translation

Researcher: Thank you for accepting to take part in my study. We will start with the general questions about the use of technology (Part 1).

Teacher three: Ok.

Researcher: What is the meaning of technology for you?

Teacher three: *The employment of human or non-human elements in a particular subject meant to address problems, design appropriate scientific solutions, development, use, manage and evaluate to achieve specific objectives.*

Researcher: Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology?

Teacher three: *Yes, I made the decision to draw on the technology when educating my students because technology has grown to be a fundamental part of our daily life and students have an outside classroom experience with technology. By integrating the use of technology education, it is possible to engage students' interest in a subject and as a result, they will be able to receive more information during learning mathematics.*

Researcher: What are the types of technology you use with those students? Why do you use those items?
Teacher three: Umm…

Teacher three: *I used interactive whiteboards with my students who have difficulties in mathematics, this tool has rapidly become popular in numerous classrooms around the world. The IWB is a multipurpose tool that represents a combination of a number of technologies in one device, including whiteboard; DVD player, slide projector etc. These are all among several recognized classroom technologies. This combination will add excitement and enthusiasm in classrooms where students are learning from this teaching method. Therefore, my reason for using this tool especially, as my head teacher gave me a chance to attended a training course on the use of smart blackboard with students who have difficulties in mathematics. This made me use this technology especially effectively after being taken through the full advantages of the potentials provided by this technology. I also do not want to forget to comment on the reward provided by the head teacher that has also had a significant impact upon me. This is when I look at the IWB and directly remember the reward, and want to "give back" to the head teacher who encouraged me to use this technology.*

Researcher: Does the technology help you cover the key mathematics concepts in the syllabus?

Teacher three: Yes (and he pointed out that after the development of mathematics curriculum by the Ministry of Education, technology has become an integral part of the curriculum. In addition, the King Abdullah Bin Abdulaziz Public Education Development Project (Tatweer) purposes to improve results of education in the Saudi Kingdom via enhancing the use of technology. There are broader education reforms in Saudi Arabia, and this project is one of its parts, which also lead to elevate the position of the Saudi Arabia between developed countries in education).

Teacher three: He pointed out that before development of mathematics curriculum by the Ministry of Education, it was difficult for him to cover the all mathematics topics in the syllabus through the use of technology in the structure of some topics at the pervious mathematics curriculum as, it did not help him find appropriate ways to present the lesson by using technology. However, after development of curriculum, he can take advantage of technology with those students who have difficulties, as the way of structuring the lesson is changed to include technology as an integral part.

Researcher: Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?

Teacher three: Teacher three pointed out that some of my students have less confidence about learning mathematics, particularly when studying concepts of multiplication, which may result in a reduced interest into continuing mathematical studies. Self-confidence has a crucial role since students with high levels of confidence often score well in their tasks. As a result, students with low confidence require the teachers to help them with mathematics topics. As a result, he tried many strategies and found that IWB can enhance students' confidence toward mathematics. In addition, some of his students have difficulties in remembering basic mathematical facts. They usually learn a section of the table of multiplication today and forget the same information the following day since performing such mental calculations in the students` head requires much of their working memory. Basically, students who do not have difficulties in mathematics often are able to save the heard information, retrieve it and use it when required. On the other hand, the students with poor working memories are not able to recall that information, as it lost. He added:

Teacher three *In order to determine changes in confidence toward mathematics and the improvement in the students' memory as a result of IWB intervention at the previous year, I tried to notice the effects of IWB on students, with a focus on enhancing confidence in mathematics and help children who struggle with working memory and mathematics. I also tried to apply that experience with these students in this year and found that the IWB approach lead to realization of substantial improvements on their memory and confidence in mathematics. I will show you your note during the classroom time that is, how this experiment works with those students to see that technology's role* *the education of mathematics is to give meanings to numbers, to enhance students' confidence and to aid in boosting the memory of the students.*

Researcher: Have you learnt anything new by using technology in your class?

Teacher three: He learnt how he uses interactive Whiteboard with students who struggle with mathematics, where this course takes place inside the school. The main goal for taking this course was to ensure that he is able to exploit all of the features of interactive whiteboard technology during use with those students who have difficulties in mathematics, which was taught by qualified and experienced teachers and trainers. When he finished a training session which lasted about two days, he was given a certificate showing that he has successfully completed this course.

Researcher: Why you chose especially this technology which Interactive Whiteboard, when you decided to attend a training course?

Teacher three: Umm…

Teacher three: *I choose this technology for two reasons; the first is that I can put a variety of strategies and techniques into practice using IWB. The second is currently and as you see, I have this tool in my class, here comes to the role of the teacher in how to take advantage of this technology in all areas of mathematics.*

Researcher: What are the main reasons behind the decision of the mathematics teacher to not use technology to help students with mathematics difficulties? (Teachers themselves, school, government).

Teacher three: *I think the school only.*

Teacher three: *I would like to explain why I chose school only and not the teachers. Because some people criticize teachers only, that he/she is the only reason behind not using technology in his class. This is regardless of the role of school administrators as a reason like the head teacher who plays a big role in setting the climate of a building. For example, I know two teachers who don't use technology in schools at all. However, when they sense a positive attitude on their head teacher, they rethink about their decision to not use technology; as a result, they now use technology with their students.*

Researcher: What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of (Training teachers to use technology? Technical support? Teacher attitudes and beliefs about teaching mathematics with technology?

Teacher three: (Teacher three believes that the major obstacle facing teachers when using technology with those students who have mathematics difficulties is the lack of technical support. According to him, disruptions are caused by the crashing of a computer and repairs done regularly in the computer will not be performed if there lies technical assistance absence. As a result, teachers would not use computers for teaching purpose. Moreover, due to equipment failure fear the teachers would be discouraged and may not use computers as case there is technical problem then there will be lack of technical support). He added:

Teacher three: *A strong association is made between technical assistance and obstacles to the use of technology in classrooms. The obstacles here include: if teachers know that there is no one for offering immediate technical support, then teachers will be discouraged from using technology.*

Teacher three: (The breakdown of equipment, not to mention the issues of complexity, high risk of losing data, embarrassments and stress were all quite difficult for him to resolve. He asked himself: what shall I do in front of 35 students if the computer suddenly does not work and there is no direct aid? Therefore, the prevalent utilization of technology in classrooms can only be achieved if there is a provision for technical assistance and maintenance when required. Otherwise, the tutors could easily disregard requirement to integrate technology, as they will waste too much time postponing their classes and awaiting a tangible solution to the technical problems).

Researcher: Do you need any further support to use technology, and if so, what support do you need?

Teacher three: (He felt no need for any further support to use technology, because the principals of his school encourage him to overcome any obstacles he face during his use of IWBs. He agrees that the availability of technology in schools is no longer the issue in education in the Kingdom of Saudi Arabia, as the ministry of Saudi has a great financial support from government to provide the necessary technology in schools. However, the current emphasis lies in ensuring that teachers can use this technology as an effectively way in teaching. As a result, this need simply leads to training teachers to keep up to date with all new technologies to promote learning for all students in the classroom.

Researcher: Thank you very much.

Teacher three: *You're welcome.*

Researcher: Thank you again for accepting to take part in my study. We will move to the specific questions to address the research questions (Part 2).

Researcher : Why did you decide to use/not use technology for this lesson with students who have mathematics difficulties?

Teacher three: *I utilized the Number Race program and PowerPoint presentation through Interactive Whiteboards to conduct this lesson (multiplication facts) because it provides a unique platform for making presentations thus, making the audience concentrate more on the screen rather than the speaker which helps in reinforcing the* *message. This is because students learn better when words are integrated with illustrations than when words are used alone.*

Researcher : Is technology used to increase basic skills, to make the understanding of complex mathematical operations easier or as a resource to entertain students?

Teacher three: *In this class, some students have difficulty in mathematics, and we know that students live in technology outside the classroom, and they use it to entertain themselves. Therefore, I always use IWB with programs that entertain students in the classroom, but with the achievement of the objectives of the lesson and to make the understanding of complex mathematical operations easier. In addition, I follow constantly know what software and applications and devices used commonly by students in their homes. "I know you will ask me now why, and the answer is simply trying to use the same ideas of these games with mathematics lesson." As a result, students will be more willing and enthusiastic to learn mathematics.*

Researcher: How often do you use technology when teaching students with mathematics difficulties?

Teacher three: Daily.

Teacher three: *However, before the development, I begun the implementation of technology slowly at first, but cannot use technology in some lessons, which makes me not use technology daily. In other words, new development in mathematics curriculum gave me a huge boost with the enthusiasm to be used a daily basis with those students who have learning difficulties. That does not mean I did not try to use technology daily before the development of the curriculum, because I believe that teaching mathematics with technology is very important.*

Researcher: Where do you usually get your ideas from for using technology? (Magazines, colleagues, workshops, technology coordinator, Internet, etc.)

Teacher three: Umm…

Teacher three: *I think it is a good question; I try to create the ideas by myself to help me deal with all these students needs. I mean by create ideas by myself when I use technology to take advantage of applications and programs that are already provided by Interactive whiteboard and combine them with my thoughts to help students who suffer from mathematics difficulties. All the programs offered by IWB will be useless unless teacher put his ideas to be used optimal and efficient use. To be honest with you, sometimes we share our experience and ideas with some of my colleagues at school which transmits enthusiasm among ourselves in the continuation of the use of technology, and this is one of the goals of the school principal.*

Researcher: Did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe? If not, how did you overcome the problem of training?

Teacher three: *No, I attended various training courses, which was designed to provide further academic and professional training in computer science for those teachers who want to gain skills and knowledge about technology field. For example, before I attended this course, I only knew that Word processing software is used for typing Text only, but after finishing the course, I knew the role of this software in mathematics.*

Researcher: If offered, how likely would you be to participate in technology training either during or after school time?

Teacher three: *I would prefer this during school time because; I do not have time after school. However, either during or after school, I am enthusiastic to learn new information to help my students. Because the school principal encourages teachers here to learn and follow-up any new technology, and use it with these students. Believe me, I love technology, but these factors will help me and my colleagues to continue using the technology without dampening. We teachers like students also need to encourage and promote, which will be reflected in our performance with the students.*

Researcher: With regard to the next question of my interview questions, "If no, what factors may have led you to not attend training sessions?" Uhummm…..I will move to question eight because you answered this question.

Researcher: What is needed to make the necessary teacher training work?

Teacher three: *As you know that primary teachers in the Kingdom of Saudi Arabia will typically work between the hours of 7.15 AM and 1.00PM, from Sunday to Thursday. Actual teaching time amounts to 20-24 teaching sessions per week. Teaching hours in Saudi Arabia may vary by school. There are additional burdens on teachers such as covering teachers' absence, supervising the students during their entry, lunch break and exit from school. It is usually the responsibility of the principal to prepare the duty roster and ensure that each day two or three of these teachers must do this work. However, the head teachers can form relation between these burdens and regular attendance for training to use technology, that the teacher who attends training sessions will reduce or delete this burden depends on the amount of attendance for training. Therefore, you will see that most teachers are racing to attend these trainings to take advantage of two things, including increasing their knowledge about the use of technology and a reduction in the daily burdens, which help them to provide more and more of their energy to students inside classrooms.*

Researcher: If you wanted a technical support in your class but it is not available in the school right now, how would you overcome this problem?

Teacher three: (He said that usually the system here in Saudi Arabia through the Ministry of Education gives each school principal a budget for the operation of the school; and the amount of budget depends on the type and size of school. All school principal use this budget by the school needs to ensure they motivate teachers and students to continue education as required).

Teacher three: (Return to the answer to question above, this teachers said that the school director was allocated a part of the budget to help them when they need support for technical emergency.

Researcher: How can we overcome the negative attitude of teachers towards the use of technology?

Teacher three: *The teachers should also have trainers who train them through active participation instead of just giving verbal information of what should be done.*

Researcher: There is time if you would like to ask questions or add comments or Umm... anything.

Teacher three: Umm... I think that all.

Researcher: Thank you very much.

Teacher three: *You're welcome.*

Transcription of Teacher's Interview
Teacher four
English Translation

Researcher: Thank you for accepting to take part in my study.

Teacher four: Ok.

Researcher: Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology? (Then I will move to questions six, seven and eight).

Teacher four: (Teacher four pointed out that they do not have any type of technology in the classrooms such as Interactive Whiteboard, projector data show and computers).

Teacher four: *I referred to these types of technologies as they are the most commonly used in the Kingdom of Saudi Arabia. Let me share something important. As we know that rewarding outstanding teachers in schools will motivate other teachers to work more and more to help students in their learning. On the contrary, if the teachers feel that there is no rewards system in their schools, this may they discourage them to make more effort. Now, since I have no idea how to use technology in class for mathematics lessons, and, thus, I have not tried to surmount this obstacle, because I need more encouragement in place in order to receive the required training and thereby demonstrate innovative teaching. As such, I did not decide to use technology, although I understand the positive impact of IWB on learning amongst students who have difficulties in mathematics. As a result, I might change my mind if there is support and encourage the use of technology.*

Researcher: What are the types of technology you use with those students?

Teacher four: (It is interesting to mention that this teacher prefer to use interactive whiteboard, if there is an opportunity to bring the technology to this school, as they have had heard a great deal about the benefits of this tool in mathematics education from their colleagues at other schools. Teacher six pointed out that he preferred this tool because the electronic IWB (interactive white board) is a device, which combined a wide range of functions that could be adapted in all mathematics lessons at all primary school levels).

Researcher: What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of (Training teachers to use technology? Technical support? Teacher attitudes and beliefs about teaching mathematics with technology?

Teacher four: Umm…

Teacher four: *As you know that I do not use technology in this school at all, but I can answer your question from my experience in this school. I found that the attitudes of the head teacher are directly related to the availability of technology and the use of it in the classroom. To be clear about the shaping of attitudes, this included the age of the director and their knowledge about computers. With regard to knowledge about computers, if the head teachers have good knowledge about the impact of technology on learning, they will help teachers by the provision of technology and supporting them during its use. I know that the Ministry of Education, supported by our government, will help the teachers by providing technology to the schools, but we want the directors to be more active in motivation and encouragement when using technology.*

Researcher: Did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe? If not, how did you overcome the problem of training?

Teacher four: (He studied one subject during my college education. This subject provided him with the necessary skills alongside knowledge of operating their computers and performing tasks. This enabled him to be acquainted with computers as well as Microsoft Windows, while acquiring basic keyboard, mouse and computer skills within a supportive setting).

Teacher four: *I benefited from this subject during my college years in various ways, for instance, switching on and switching off the computer, undertaking key tasks using Excel, PowerPoint and word processor, organising print settings alongside documents, utilizing a web browser for internet access coupled with posting and retrieving electronic mail.*

Teacher four: Can I add an interesting point.

Researcher: Yes please.

Teacher four: Umm...

Teacher four: *As you observed during my teaching in the classroom with those students who are suffering day after day from the mathematics, because my teaching methods are not in line with the new mathematics curriculum, which was developed by the Ministry of Education, these are important issues. We see that presenting the curriculum for students needs to be augmented by technology to facilitate students' learning of mathematics, before aggravating the problem and then leading to a situation that cannot be controlled.*

Researcher: How can teachers overcome the negative perceptions of principals towards the provision and encouragement to use technology?

Teacher four: (He discussed the importance of the use of technology in mathematics particularly with students who have mathematics difficulties. Therefore, he thinks that if the teachers discuss their need of technology and show them the advantages of the use it, this may help teachers to change head teachers' attitude).
Researcher: Thank you for your time.
Researcher: Would you like to add anything.
Teacher four: *No.*
Researcher: Ok.
Researcher: See you and take care.

Transcription of Teacher's Interview
Teacher five
English Translation

Researcher: Thank you for accepting to take part in my study.

Teacher five: Ok.

Researcher: Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology? (Then I will move to questions six, seven and eight).

Teacher five: (Teacher five gave wise advice before answering the above question. He pointed out school leaders can have an impact on enhancing better instructor performance, and student outcomes if their leadership practices, reflective encouragement and motivation is supportive).

Teacher five: *Hence, the teachers are directly influenced by the leadership quality of principal. This encompasses the manner they perform, do their planning and take decision upon their teaching approaches along with practices of learning. It also includes their individual competence, dedication and intellect of welfare, along with their faith and devotion for the school that puts an impact on results of learner indirectly. I will link my thoughts to your question: why do I not use technology? I believe that interactive whiteboard has a significant impact on students, especially those dealing with the difficulties of mathematics, and that some students here have concerns about learning mathematics and in order to help them effectively requires an entertainment mechanism through which students are encouraged to learn mathematics with confidence and fun. However, this school does not have the technology, and even if we assume that, hard work was devoted to acquire such technology, we are aware that the Ministry of Education has a sufficient number of devices, but I find yet another obstacle, that indicates a lack of effective training to use technology. Even if we assume that diligent work had been undertaken to provide us with training courses; there is a lack of technical support to help us when needed. All these obstacles accumulate because we need more support from the principal to remove these obstacles.*

Researcher: What are the types of technology you use with those students?

Teacher five: (It is interesting to mention that this teacher prefer to use interactive whiteboard, if there is an opportunity to bring the technology to this school, as they have had heard a great deal about the benefits of this tool in mathematics education from their colleagues at other schools. Teacher six pointed out that he preferred this tool because the electronic IWB (interactive white board) is a device, which combined a wide range of functions that could be adapted in all mathematics lessons at all primary school levels).

Researcher: What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of (Training teachers to use technology? Technical support? Teacher attitudes and beliefs about teaching mathematics with technology?

Teacher five: Umm…

Teacher five: *Investigating principals and instructors' perception towards technology within the education system is a valuable gesture. This is because developing constructive perceptions about the school as well as learning is a critical precursor towards academic success. Conversely, negative perceptions hamper the achievement of academic success. In my opinion, positive attitudes toward technology are important prerequisites to helping teachers successfully integrate and use technology in the classroom. I presented such a speech to school principals based on my experience. To summarize, the major obstacle facing teachers when using technology with students is the attitudes of head teachers towards technology, which leads to a lack of attention with respect to the provision of technology and the facilitation of the presence of technical support in schools. This results in the discouragement of teachers to attend training courses. Eventually, we will find many other obstacles which must be overcome.*

Researcher: Did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe? If not, how did you overcome the problem of training?

Teacher five: (He studied one subject during my college education. This subject provided him with the necessary skills alongside knowledge of operating their computers and performing tasks. This enabled him to be acquainted with computers as well as Microsoft Windows, while acquiring basic keyboard, mouse and computer skills within a supportive setting).

Teacher five: (Teacher five spoke morosely because he did not practice what learnt at his University in his classroom).

Teacher five: *I learnt from this subject the essential computer skills only, including Word-processing, using a Spreadsheet, using Power Point, printing the document, using the Internet and how to open, send, receive and close email.*

Researcher: Do you have anything to add?

Teacher five: Ya…Yes.

Researcher: Ok go ahead.

Teacher five: (He agreed that the students have access to technology to entertain themselves outside the classroom, and he knows that mathematics is difficult subject for students. To make mathematics easier and address their misconceptions, we must, as educators, seize opportunity from their love of technology and merge it with the subject of mathematics, which will lead to future student perceptions that mathematics is not difficult).

Teacher five: *I hope to hear soon that technology will be used in this school, because the benefits of it are clear to us as teachers. This was apparent when a competition in mathematics took place between some of the students of this school and some of the students from another school. When we found, at the end of competition, that the students in other school outperformed our students by degrees, we were disappointed.*

Researcher: How can teachers overcome the negative perceptions of principals towards the provision and encouragement to use technology?

Teacher five: (He discussed the importance of the use of technology in mathematics particularly with students who have mathematics difficulties. Therefore, he thinks that if the teachers discuss their need of technology and show them the advantages of the use it, this may help teachers to change head teachers' attitude).

Researcher: Do you have any question or comments or anything

Teacher five: No…

Researcher: Thank you for your time.

Teacher five: *Welcome*.

Transcription of Teacher's Interview
Teacher six
English Translation

Researcher: Thank you for accepting to take part in my study.

Teacher four: Ok.

Researcher: Do you use technology in your classroom to help students with mathematics difficulties? If so, why did you decide to use technology? If not, why do you not use technology? (Then I will move to questions six, seven and eight).

Teacher six: (In his opinion, the school head acts as intermediaries who encourages, supports and helps teachers to use technology for teaching/instructions and process of learning, and hence incorporated technology within the system of education. The school principal's assistance is very important as the success related to technology incorporation into learning and teaching depends on it. Therefore, the principal can either be a critical factor facilitating or hindering teachers' use of computers for the purpose of education).

Teacher six: *I mentioned this information about the head teachers, because I met three head teachers at different schools during my work, I noticed that the head teacher's age is an important factor influencing technological integration in schools, because one of them was younger than the other head teachers, and he knows the important of technology in teaching and learning, and was, therefore, willing and enthusiastic to provide and encourage the use of technology in our classrooms. We may conclude that the age factor will affect enthusiasm to provide such technology in schools as well as offer encouragement to use it. In addition, he holds a bachelor and diploma in computer science, and he received in-service training about the effect of technology on education and how to encourage teachers to use technology. Another head teacher, has a bachelor's degree in mathematics, and has not received training in either the use of technology or its impact on students. Because without a doubt, in-service training emerged as an important factor, which may improve the school heads' perception towards computers, thus facilitate their efforts of integrating computers into the learning institutions. All of these factors concerning the background and orientation of head teachers may reflect negatively on teachers' decision to use technology with their students. However, I still believe that technology has a positive effect on students, particularly those with difficulties in mathematics.*

Researcher: What are the types of technology you use with those students?

Teacher six: (It is interesting to mention that this teacher prefer to use interactive whiteboard, if there is an opportunity to bring the technology to this school, as they have had heard a great deal about the benefits of this tool in mathematics education from their colleagues at other schools. Teacher six pointed out that he preferred this tool because the electronic IWB (interactive white board) is a device, which combined a wide range of functions that could be adapted in all mathematics lessons at all primary school levels).

Researcher: Does the technology help you cover the key mathematics concepts in the syllabus?

Teacher six: Umm…

Teacher six: *Before the ME (Ministry of Education) developed the mathematics curriculum, I found it difficult covering all mathematics topics within the syllabus with computers, there were some topic structures in the past mathematics curriculum, that were not helpful to me with regard to finding a suitable means of presenting the lesson through technology. However, following the curriculum development, I can easily use technology on learners with difficulties because the lesson has been structured in a manner that allows the use of technology. In this school, I have had difficulty in dealing with the curriculum without the technology which the curriculum requires, especially after its development.*

Researcher: Do you think that technology can help students with mathematics difficulties to learn, and if so, how can it help the learners to learn?

Teacher six: Umm…

Teacher six: *This will happen in two ways. The first is to enhance the teaching quality through improving the interaction, communication and collaboration levels; moreover, encouraging learning by increasing motivation and readiness of students to solve mathematical problems.*

Teacher six: Umm…

Teacher six: Ya… this is my opinion.

Researcher: Have you learnt anything new by using technology in your class?

Teacher six: (Teacher six reported that in 2010 he learnt how to use Interactive whiteboard with students with mathematics difficulties. He selected the electronic IWB (interactive white board) because it is a device that combines variety of functions, and can be used in every primary schools' levels for teaching mathematics lessons).

Teacher six: *The head teacher in the school I was affiliated with in 2010 tried to encourage us to attend the necessary training to learn the effective use of technology with students. In addition, in certain instances, the director also attended the training sessions, sending us a valuable message as role models, saying in effect, that: I encourage that you and I attend these sessions to enhance knowledge and that this technology will facilitate my work in administration as well as yours in the classroom.*

Researcher: What do you believe is the major obstacle facing teachers when using technology with those students who have mathematics difficulties in terms of (Training teachers to use technology? Technical support? Teacher attitudes and beliefs about teaching mathematics with technology?

Teacher six: Umm…

Teacher six: *I want to add or to clarify my answer to the first question, which will enable me to better answer it. As I mentioned before, the age and in-service training of the principals are critical factors that may affect technology integration and use at schools. I would add herein that teachers' or a head teacher's field of study is correlated to their attitudes toward technology. As you know I have experiences with three head teachers, with the first one holding a bachelor's and diploma in computer science. He currently works with the Ministry of Education to provide IWB for all classrooms. However, the second head teacher held a bachelor's degree in mathematics, and did not support the provision of IWB in their school.*

Teacher six: (Therefore, he concluded that head teachers who graduated from computer subjects appear to have positive perceptions and attitudes towards technology and its integration into teaching and learning. He added that, in his opinion, the major and most important obstacles that faced teachers are the attitude of head teachers toward technology in term of provision, integration and use in the classroom. If this obstacle is overcome, then it will be easy for us to address other obstacles faced when using technology, such as the lack of training and technical support).

Researcher: Is technology used to increase basic skills, to make the understanding of complex mathematical operations easier or as a resource to entertain students?

Teacher six: Yaa…

Teacher six: *I think both, in order to provide a better understanding of complex mathematical operations and as a resource to entertain students. I knew that you would ask me 'how', therefore, I will explain it to you. Current students live in a world of technology outside the confines of the school, using many different types of technology now available in markets, and they use it to entertain themselves. Some parents are intelligent, in that they try to add some applications in their children devices to support their children's at home 'explorations', wanting their children to use technology as a learning resource. As a result, before I came to this school, I used IWB every in single lesson with programs that entertain students in the classroom, but also achieving the objectives of the lesson and making complex mathematical operations easier to understand. Some parents also wanted to take advantage of this entertainment technology and involvement with the objectives of the lesson, in order to become more effective in helping students understand and love mathematics.*

Researcher: Where do you usually get your ideas from for using technology? (Magazines, colleagues, workshops, technology coordinator, Internet, by yourself, etc.)

Teacher six: Umm…

Teacher six: *From myself and the internet.*

Teacher six: *I commonly capitalize on the software and programs offered by the IWB and incorporate my ideas to assist learners with mathematics difficulties. Notably, all programs provided by IWB would be irrelevant if the instructor does not put his/her ideas to proper and constructive activities. Moreover, in some instances, I visit certain internet sites to acquire knowledge on the experiences of mathematics instructors.*

Researcher: Did your college education include any learning activities on how to use technology for teaching those students? If yes, please describe? If not, how did you overcome the problem of training?

Teacher six: (He studied one subject during my college education. This subject provided him with the necessary skills alongside knowledge of operating their computers and performing tasks. This enabled him to be acquainted with computers as well as Microsoft Windows, while acquiring basic keyboard, mouse and computer skills within a supportive setting).

Teacher six: (Teacher six pointed out that basic computer skills are a must in today's school. I asked him what he learnt about such skills at University).

Teacher six: *I know I learned some basic principles for the use of the computer, but I remember that the lecturer did not cover a lot of topics, such as how to use Internet effectively.*

Teacher six: I would to mention something please.

Researcher: Take your time.

Teacher six: (He agreed that the students have access to technology to entertain themselves outside the classroom, and he knows that mathematics is difficult subject for students. To make mathematics easier and address their misconceptions, we must, as educators, seize opportunity from their love of technology and merge it with the subject of mathematics, which will lead to future student perceptions that mathematics is not difficult).

Researcher: Yaa

Researcher: By the way, I would like to ask you about the competition and your opinion on the results of the students and the reasons for the low grades of your students.

Teacher six: *Yes, there was a competition between our school students and students from other schools in mathematics. The competition was dependent on agility and intelligence. I was surprised at the results of the competition which found that their students surpassed our students to a significant degree. When I met with their mathematics teacher, I asked him about their secret and he told me proudly, 'I use smart interactive whiteboard with my students which made them come to love mathematics and do exceedingly well in competitions'.*

Researcher: How can teachers overcome the negative perceptions of principals towards the provision and encouragement to use technology?

Teacher six: (He discussed the importance of the use of technology in mathematics particularly with students who have mathematics difficulties. Therefore, he thinks that if the teachers discuss their need of technology and show them the advantages of the use it, this may help teachers to change head teachers' attitude).

Researcher: Do have any comments or questions.

Teacher six: No.

Researcher: Thank you for your time.

Teacher six: *Welcome.*

Appendix 23

Transcription of Classroom Observations
Teacher one
English Translation

School	**A with technology.**
Date	**25/09/2014 - 10/11/2014**
Number of the lessons	**30 lessons.**
Each class period	**45 minutes.**
Class level	**Year six**
Number of students	**20**
Mathematics lesson	**Multiplication**

1- The description of the laboratory and my observations

First of all, this teacher spends some lessons with his students in the laboratory. Therefore, I would like to give the reader the feeling of this laboratory, in terms of what it looks like, how its furnishings and contents are arranged, bulletin boards, and its physical atmosphere. This undoubtedly has a direct impact, not only on the learners, but also on the teacher.

When you enter the laboratory, you will find that the four walls are coloured in green. After my first observation of this teacher, I asked him why these walls are painted in green colour, because I noticed that all the other classroom walls in the school were white in colour, except this laboratory. His answer was as follows:

> *I believe that students who have difficulties in mathematics need this colour to alleviate stress and anxiety from mathematics and to relax. Eventually, I will be able to help them eliminate all the difficulties they face, easily.*

After entering the lab, you will find on the right side an interactive whiteboard, and on the left side students' seats, which I noticed were arranged in a semi-circle. Every student has a computer totalling 20, and they could not use it without prior permission from the teacher. At the beginning of the lesson, the teacher asked all students to look at the Interactive Whiteboard and explained the daily lesson and then after 20 minutes, the teacher allowed them to use the computer to practice what they learned during the lesson. It is worth mentioning that this lab does not have a special table and chair for the teacher, because this teacher believes that the role of the effective teacher is to stand in front of students with constant interaction, and meet all the needs of individual students by walking around, watching, and evaluating student progress. He said this would not be possible if the teacher sat on the chair without any interaction or observation of the students.

Classroom environment

Moving to the classroom environment, the teacher created a friendly environment inside classroom, and this was evident seeing the students' cooperation with each other. For instance, when the teacher finished explaining the whole lesson, usually 10 minutes before the end of class, he asked all students if they had any questions about the lesson. One or two of those students raised their hands, which meant they had questions. I noticed that in each class, the teacher asked one or two students from the rest of the learners that did not raise their hand, to go and help them answer their questions. I noticed that all students were competing to get a chance to help their friends; this appeared when I saw all the students' hands raised wanting to participate in helping. I do not want to forget that while the students got help from their friends, the teacher constantly walked around the learners to make sure that a student who raised a hand got the correct answer. This means that the assistance that the student received was also under the supervision of the teacher. All this came about because of this teacher, who wanted to make the class environment friendly, increase students' confidence, develop leadership, and ensure that all of them understood the lesson well.

Encouragement in the Classroom

With regard to encouraging students to interact and effectively participate in classroom, I noticed that the teacher divided the students to two groups; the first ten in group A and the other ten in group B, where the total strength of students in this class was twenty. Usually in the middle of the class, the teacher asked questions in an interesting way using an interactive Whiteboard. The first group which responds to a question immediately will get three points and so on. Indeed, I noticed three benefits to the students when their teacher used this method. The first is that the students were keen to participate in front of their friends to get positive feedback from the teacher, whether the answer was right or wrong. That led to the continuity of student participation in the classroom without feeling bored; boredom is a result of lack of concentration during a lesson. The second is that the group which collected more points won. The teacher then put their names and photographs on the board outside the classroom. This generated an enthusiastic discussion among all students in the school about these students and every student wished that their names and photographs be on this board in the future, leading them to strive more and more to get on this board.

2- Information about the students in this laboratory

According to my observations and the teacher evaluation sheets, I found various types of difficulties that some students have in this classroom. These difficulties included failing to understand that any number multiplied by zero equals zero. However, I noticed another difficulty that this teacher did not mention during the interviews that some students thought of multiplication as always resulting in bigger numbers such as 0, 5× 3= 3. In addition, some of them also when multiplying three by zero in the previous task answered 3, because they cannot imagine that multiplication does not always result in a bigger number.

During my observation, I also noticed the reasons for this teacher’s intensive focus on the multiplication. Because he believed that the students' understanding of multiplication effectively will facilitate learning equivalence, fractions, division facts, and long division. He used IWB with all lessons, but he creatively used an interactive whiteboard with this lesson in particular.

I could see from the teacher evaluation sheets for students that there were two kinds of students in this laboratory. Some students of the 20 have anxiety and depression from learning mathematics. Some others students show enthusiasm, optimism, and curiosity when learning. During my observation, I did not notice any behavioral problems among all students, except for two students in some lessons; they did not raise their hands to take permission from the teacher before doing things such as going to the bathroom.

3- The lessons for which this teacher tried to use technology and how

I noticed that this teacher used one type of technology, which was IWB for each single lesson with those students who have mathematical difficulties. This means that for the period of my observation, he used this tool with lessons such as mathematical equivalence, fractions, multiplication, and division. Backing up a little to the previous comments, I can find in his answers to the interview questions, the reason for his using of this tool particularly. However, this method helped me more and more to investigate how he used this technology to help his students with multiplication difficulties.

As mentioned before, some students have specific difficulties in mathematics, which centred on the lack of full understanding of multiplication concepts, which has already affected their understanding of the rest of the mathematics concepts such as equivalence, place value, fractions, and division. Therefore, in the first four weeks of observation of this teacher, I found that the teacher used a specific program to facilitate the difficulty they faced on the concept of multiplication. In the fifth week onwards, I noticed this teacher started to move to another concept in mathematics. However, he took the first five minutes of each lesson to recollect the previous program with those students, reminding them the concept of multiplication. Therefore, I am interested here to show you how he used the program, particularly with this concept.

Indeed, I noticed that the teacher used Mighty Mathematics Number Heroes program through the IWB. This means the teacher benefited from IWB during his use of the program. For instance, using the board with his finger as a mouse to control the program on his computer, highlighted the corresponding material on the mathematics task with ‘electronic ink,’ and saved any annotations or writings he made.

In regard to my observation of the use of this program and its effect on 20 students during 45 days, as one of my goals, I found this program, which is about playing with the basic building blocks of mathematics, suitable for students aged 8 to 11. This program took those students to visit mathematics metropolis where friendly number heroes rule the day. Through a picnic in this program, students faced a set of mathematics activities that encourage experimentation and investigation. One of these activities was turning the difficulty of understanding the concept of multiplication into learning through fun and to make learning enjoyable. This teacher was keen to use part of this program to help his students with learning multiplication and understand it clearly.

During my observation of the teacher in the first month, I noticed that usually at the beginning of the class, he started to explain the concept of multiplication to all students by using this program. After 20 minutes into the class, he asked three to four students from both groups to come to the Interactive Whiteboard and practice what they learned; this activity was repeated. During this time, the teacher also asked the rest of students in both groups to follow their friends on the board and encouraged them to win. At the end of the last ten minutes, the teacher allowed each student to use this program in their computer, under his supervision. It is also important to mention that during my observation of the first month of this teacher, he tried to gradient and move slowly to other topics in mathematics such as division and fractions, but the main focus was to help his students overcome the difficulty in understanding multiplication.

In the last two weeks, I noticed that the teacher tried to fully move on to other topics in mathematics; the main focus of these two weeks were on other topics in mathematics such as division, and this happened after he made sure that the difficulty these students faced disappeared completely. However, during the first five minutes of each class, he switched this program on to double check that those students did not have any difficulty with it.

4- The effects of technology on students with difficulties in multiplication

The purpose of this point was to identify if IWB had positively influenced teaching and learning, which is divided into two parts: general learning and particularly, learning of the concept of multiplication.

In regard to teaching, I noticed that this tool had positive effects on the way the teacher taught the students. These results appear in many parts, but the most important one was when the teacher used the save feature of the lesson to be opened later at any time. This supported the teacher in the delivery of new information and linked it to the previous information easily, keeping his students familiar with all the concepts taught during his building blocks classes of basic mathematics, recalled by only a push of a button. This also saved the teacher time.

Generally, as I mentioned early, according to the teacher evaluation sheets for students, some students of the 20 had anxiety and depression because of learning mathematics. During my observation, I noticed that the teacher was able to shift these to a more motivated and active mindset through the use of the interactive whiteboard.

Particularly, we know that most of those students have difficulties in learning the concept of multiplication. In relation to that difficulty, I noticed that this program was able to build mathematics confidence, which gives students a strong foundation to build on, in a fun and interactive way while challenging all students. In addition, at the end of the last week, I noticed that all the students easily remembered the concepts of multiplication when they solved the task on hand, which indicated that they had overcome the difficulties they faced.

It is interesting to mention that I noticed this teacher not using this tool randomly; he was keen to choose programs that helped students participate more in Laboratory, persist through difficulties, and succeed in overcoming difficulties. In these programs, he did not give tasks to the students that led to the promotion of anxiety.

5- The challenges faced during the use of technology

I noticed the reflection of the positive impact of their head master's support on this teacher, in terms of providing appropriate devices and programs, technical support, and teacher training.

With regard to implementing the program, I could see that any support this teacher needed, he asked the head teacher unhesitatingly to provide, and then would get it the next school day. Moving to the provision of technical support, I noticed that in the fourth week, the lamp of the projector burned out in the first ten minutes of the class. Indeed, there were two things that impressed me: the first is how this teacher dealt with the situation confidently. I saw this before my own eyes, when his students did not feel any unease; this teacher gave them some tasks to solve while the technician fixed this issue. The second observation was the speed of the technical response to the teacher's request. When the lamp burned out, the teacher immediately informed the person who has experience in this matter, and we waited a very short time before he came to the laboratory, encouraging this teacher to use the technology constantly.

6- Summary

To sum up, some of the students in this classroom have difficulties in multiplication concepts, which included failing to understand that any number multiplied by zero equals zero and understanding that multiplication does not always make bigger numbers. Their teacher used Mighty Mathematics Number Heroes program through the IWB, which benefited from the great features offered by this tool to help students. As a result, I noticed the positive effect of this tool on teaching and learning. This helped the teacher save the lesson through IWB, and open it at any time during the lessons when he needed it to connect the previous information to the new one, saving the teacher precious time. In regard to the students' learning, I found its effects on learning positive; this was evident when I saw the ability of this tool in shifting anxiety and depression among students of mathematics to a more motivational and active state. And particularly on learning multiplication concepts, I found it useful in building students' confidence. Finally, this teacher did not face any great challenges during his usage of the IWB, and this is a reflection of the positive impact of their head teacher in providing the interactive whiteboard, technical support, and teacher training.

Transcription of Classroom Observations
Teacher two
English Translation

School	**A with technology.**
Date	**25/09/2014 - 10/11/2014**
Number of the lessons	**30 lessons.**
Each class period	**45 minutes.**
Class level	**Year four**
Number of students	**20**
Mathematics lesson	**Subtraction**

1- The description of the classroom and my observations

This classroom is spacious and has interactive whiteboard, projector and one computer. All the three tools are connected together which allowed the teacher to control the computer directly from the whiteboard. I just realized the reasons mentioned by this teacher about the use of interactive whiteboard during the interview. It appeared in two scenes, the first when I saw how this tool simplified the difficult task and presented it in the form of entertainment. This scene reflected positively on the students, and I can see it through my observations in this classroom. These included the positive progress of the students in grade's daily assessment and the students' reaction when the teacher enters the class to start the lesson; they showed signs on their faces to show enthusiasm and ready to start the lesson. The second is the development of mathematics curriculum by the Ministry of Education which helped this teacher for daily use of this tool.

Coming back to the description of this class, I can find posters on the walls on the right and the left of the students which the teacher had put with motivational pictures and words such as 'mathematics is easy', 'I am intelligent' and 'I can do it'. During my observation, I noticed that if the students face any difficulty while solving the task, the teacher would ask the students to see the wall and read the poster 'I can do it' or 'I am intelligent'. As a result, this gave those students the power to continue to solve the task and not feel bored of mathematics.

Seating arrangements

In regard to the seating arrangements, I noticed that the teacher put the students' desks grouped in five, that is, each five students in one group. In some lessons, the teacher asked all groups questions, explaining that the quickest answer he would get from any group would result in more points or stars. I saw the competition between the groups, especially when the question needed a long time to answer it. I heard some students in each group asking their friends “who knows the answer.....quickly before them” and “quickly .... quickly before them”. Therefore, this method of arrangements helped the teacher to monitor the student work and increased competition between the groups. In addition, it helped the students to increase the positive relationships between them through cooperative learning, which lead to building their knowledge, skills and understanding.

2- Information about the students in this classroom

With regard to the difficulties these students have with mathematics, I found that some of them in this classroom struggled with subtractions, which is divided into two parts. The first comprised some students who had difficulties when borrowing from zero in subtraction calculations, for example, when they have to subtract 352 from 500. The second is some others who avoid the first difficulty by starting from $5 - 3$ and then $0 - 5$ and $0 - 2$ when they subtract 352 from 500, and the difficulty became more complex for them because they wanted to avoid dealing with the zero at the beginning of the task, and they made a mistake when they start to solve the task on the left side instead of right side. In addition, I noticed that when some of those students reach to solve $0 - 5$ and $0 - 2$, they answered 5 and 2, and some others stopped solving with a big question mark in their face. It is important to mention that I knew both these types of difficulties according to an assessment paper held by the teacher and my observations.

Students’ behaviour in the classroom

Moving on to students’ behaviour in the classroom, indeed I noticed that the students were very friendly between each other, they heard the teacher's instructions respectfully, and took care of their classroom property. Therefore, I did not notice any behavioral problems among students. This was because I noticed that their teacher tried to promote positive behaviour before problems arise. In addition, he kept all students busy and challenged through his use of IWB which would make any disruptive behavior less likely to happen.

3- The lessons for which this teacher tried to use technology and how

During my observation, I noticed that this teacher used IWB for every lesson with their students such as mathematical equivalence, fractions, multiplication and division. However, as some of his students struggled more with subtraction, I noticed that the teacher tried to use the IWB with more creativity and innovation in subtraction lesson than the other lessons.

In the first week, the teacher began with topics based on the contents in the mathematics book. The second chapter in the book is about addition and subtraction which consists of all subtraction tasks. Therefore, the teacher spent two and half weeks to complete this chapter. It is interesting to mention that after two and half weeks, there were five students who had difficulty in subtraction. The teacher moved on to the next chapter on the last two days in the third week with a focus on these five students by reviewing and simplifying the difficulty they face, in order to help them to adapt to new lessons. To give you an example of this, at the beginning of the fourth week, I noticed that two of these students said to the teacher that they did not understand the long division at all, because they still carried with them the remnant difficulty of subtraction. As we know the work with long division, students rely on previous skills in dealing with subtraction to find the solution to the task of division. At the end of the last week of my observation, I noticed that one of the five students still had the difficulty with subtraction, making the teacher perform a new plan with this student through IWB to help him more and more.

How this teacher used the IWB with his students during 45 days

In regard to how this teacher used the IWB with his students during 45 days, it is important to go back a little of my saying above that this teacher tried to use the IWB with more creativity and innovation in subtraction lesson than the remaining lessons. Indeed, as I noticed that when the teacher used the IWB with subtraction lesson, he tried to use something interesting with more effort. For instance, two days before the lesson, the teacher asked six students who had begun to overcome the difficulty of understanding the concept of subtraction to represent and embody subtract 352 from 500 in which the teacher put on the body of each one of them a poster paper with the number written on it. The first student represented the first zero on the right, the second one represented the second zero, the third student for number five and so on. It is important to mention that the teacher put those students in the form of a real task so that under the student who represented the number zero on the right was the student who represented the number two, and then under the student with number second zero was the student with number five, and so on. Then the teacher asked one of the students who had difficulties in understanding subtraction to go to the first student who represented first zero and ask him can I subtract you on 2 and he answered no it does not work, please go to my neighbour and borrow from him and so on. Eventually, the student reached to the student who represented number five, and he answered yes you can borrow one and take it to the next door which is number zero and so on. The teacher added some sound effects on this video through IWB beneficiary of the huge potential offered by this tool. For instance, when the student moved from number zero to the next zero, I heard knock sound and fantastic word appeared from IWB which gave more interaction and excitement between those students.

4- The effects of technology on students with difficulties in subtraction

In this section I will divide the effect of IWB on three aspects; these include teaching, learning in general and learning the concept of subtraction in particular.

In regard to teaching, I noticed that this tool saved the teacher's time in classroom. For example, as per my experiences in education sector, I noticed that some teachers at the beginning of 15–20 minutes tried to write the tasks on the board and then started to explain the lessons to their students in many ways, which left little time of the class. Therefore, I found that this tool helped to save the teacher's time because he had already saved all the lesson advances on USB Flash Drives, making him only to put this flash drive on the computer and open it through IWB. This way gave this teacher the chance to help those students more by starting immediately to explain the lesson instead of wasting time on writing on the board.

Moving to the effect of IWB on learning, in general I noticed that from the teacher's evaluation sheets for students and my observations that this tool enabled to overcome the challenges that arise from these difficulties. In regard to its effect on learning the concept of subtraction, I noticed that also IWB was able to reduce the number of students who had difficulty in mathematics, which showed the speed of response of students to overcome the difficulty by learning with engagement. This showed that the effectiveness of this tool to draw the students' attention made them to like mathematics which led to their desire to overcome all the difficulties they face.

5- The challenges faced during the use of technology

I did not notice any challenges this teacher faced during my observations. This means that I can see through my eyes what this teacher had answered me for the eighth question during his interview that the school principal has a positive impact on teachers in this school, making them to continue with enthusiasm to use the technology with students.

6- Summary

To sum up, it is clear from all lessons that some students had difficulties in understanding subtraction concepts. Some students had difficulties when borrowing from zero, and some other had difficulty to understand that they have to start on the right while solving the task such as subtracting 352 from 500. However, the teacher had intense desire to help those students with difficulties in mathematics. These appeared when I looked at his classroom environment, it included the way the class is organized, the psychological environment, motivation, competition and his positive relationships with the students. All the examples that I mentioned in the description of the classroom section proved that the learning or classroom environment can be a part of enhanced learning. The next part was the use of IWB and its effects of teaching by saving the teacher's time, in learning mathematics generally by reducing the negative results that were caused by the difficulty and drawing the student's attention and in learning the concept of subtraction particularly by drawing the students' attention that led them to like mathematics which resulted to overcome the difficulties they faced. Finally, as I found interestingly this teacher did not face any challenges, and this was because of the positive role of the school principal with the teacher.

Transcription of Classroom Observations
Teacher three
English Translation

School	**A with technology.**
Date	**25/09/2014 - 10/11/2014**
Number of the lessons	**30 lessons.**
Each class period	**45 minutes.**
Class level	**Year five**
Number of students	**25**
Mathematics lesson	**Multiplication**

1- The description of the classroom and my observations

Before I entered this classroom, I found a 42-inch TV fixed on the inner courtyard of the school, and the teacher had drawn a large image of the sunshine with a funny face on a white cork board which was next to the TV, and he wrote inside the sun with beautiful handwriting 'Mathematics is Very Easy'. Indeed, when I saw a 42-inch TV, I got the first internal impression that this teacher had a great fondness for technology. In addition, he had a strong desire to benefit from all the positive potentials that were provided through technology and use it to serve the students who had difficulties in the concept of multiplication.

I noticed that every day this teacher put a picture and the name of the students who exceeded difficulty. One day I tried to stand away from the TV to observe the students' reaction, particularly who are going through this tool. I was stunned from what I saw and heard from some students such as I wish that instead of this student I will study to become better than him. Actually, I found that the teacher wanted to encourage students through TV to have positive competition to overcome the mathematics difficulties that were faced by his students with good time. Furthermore, not only this way encouraged those students in this classroom, but also I saw the interaction between all the students in the school.

After looking at the TV that was located outside the class and the image of sunshine, I entered this class, in which I found an interactive whiteboard, projector and one computer. When I turned my head on the wall side, I also found a large board to show the work and achievements of his students, which gave me a clear picture about the previous and current positive student achievements. In addition, I noticed that he used this panel with the idea of stars; that is, if any student has a positive progress in mathematics, the teacher puts a star under his star, and at the end of each week, the learner who collected more stars will get a reward from the teacher. I saw the positive effect on the students and their eagerness to get more stars, which lead to overcome the difficulties within a short time.

After looking at the wall, I turned my head to the seating arrangement which I found that this teacher had put them in a semi-circular arrangement. This method helped the teacher in controlling the class and observing their actions more easily.

2- Information about the students in this classroom

It is interesting to mention that a large number of the students in this class had difficulties with the concept of multiplication. According to the teacher's evaluation sheet and my observations, I found that this difficulty differed from one student to another which I can divide it into two parts. The first is that some students imagined that the concept of multiplication is the same role of the concept of addition in terms of dealing with zero, which they think that any number multiplied by zero does not equal zero. I noticed even the teacher tried to clarify through IWB for them that any number multiplied by zero equals zero and they understood well. However, after two or three lessons when the teacher asked the students such as ten plus zero they answered zero. The second is that another set of students when multiplying 500 by 232 they directly dealt with the zero as subtraction rule and for which they borrowed from the next number. In addition, I noticed that two students in this class which the teacher did not tell me about them, when they dealt with subtraction task, they took a long time to answer to the teacher for $10 - 7$ or $8 - 4$; sometimes one of them took a long time and answered wrongly such as $20 - 13 = 5$, $10 - 7 = 6$ and $8 - 4 = 5$, which he answered with confidence.

Indeed, I noticed that there were four reasons of having this difficulty which resulted from the trouble in correctly understanding the role of zero in multiplication, incomplete knowledge, over generalization from addition and subtraction and memory problem.

Students' behaviour in the classroom

Moving on to students' behaviour in the classroom, I noticed positively that they followed the teacher's rules very well. For instance, they put their mathematics book, notebook, pen and eraser on their table before the teacher came to the classroom, as he asked them. In addition, when the teacher, at the beginning of the classroom time, asked the students to look at the interactive whiteboard only, without opening the textbook, they would do so to focus with the teacher during his explanation of the lesson. On the other hand, when the teacher asked all students a question, I found that during some lessons three students would leave their places and go to the teacher's table and raise their hand, as they wanted to answer, even if they did not know the answer. Generally, the behaviour of students was positive; even those three students did that action as they saw enthusiasm and interaction from the teacher through the use of IWB. However, I see that this action will not give the opportunity to the rest of the students to participate.

3- The lessons for which this teacher tried to use technology and how

I noticed that the teacher used the IWB in every single mathematics lesson. As some of his students have difficulties with multiplication, I noticed that this teacher used Number Race software through the IWB to rebuild those students' confidence with addition, subtraction and multiplication concepts and to be able to reach to the concept of multiplication without difficulty or misunderstanding through this strong construction.

In the first week of my observations, I noticed that this teacher followed the book contents while providing lessons for students. The second chapter was about addition and subtraction. However, before the teacher begun with that chapter, he tried to review what they learned in the previous three years about the role of addition and subtraction with zero which took about two weeks as I mentioned earlier to build those students strongly to be able to overcome the difficulties they face in multiplication.

In the third week, the teacher begun to move gradually to chapter two and took the zero rule into consideration, which took two weeks. In the last two weeks from my observation, I found that the teacher ensured about their fully understanding of the chapter two and then moved to the third chapter which was about multiplication concepts.

In regard to how he used The Number Race software through the IWB in the first two weeks, I noticed that acutely students had to play a comparison game, in which there are two main screens. Each screen had a task such as 10 + 5 = 15 and 10 + 4 = 14. In this situation, the students had to carry out a numerical comparison task, choose the larger quantity, pick the screen with the larger quantity and finish the game within a specific time period. Each task was more difficult than the previous one, in which at higher levels, the student had to add or subtract in order to make a comparison, and at the end, the students could collect their reward and could start a new phase of play with a new character. Indeed, I noticed that IWB had greatly facilitated management of this program in terms of turning on and off, using the teacher figure to highlight any important point to make it clear for the students. This teacher also used the camera to take both photos and videos of those students while using the program.

It is interested to mention that in the last two weeks from my observations, the teacher used the PowerPoint presentations to connect what students learned through The Number Race software and multiplication concepts. Indeed, the teacher did a good action by taking all the pictures and videos in the first two weeks and added them in the PowerPoint program. For example, when the teacher started to open the first presentation, I found that video clip and pictures embody the students' participation during the first day of their use of that program, and then the teacher started to connect this video on the introduction of the multiplication concepts and so on. Indeed, I noticed that the content and the goal differed from day to day. However, the general idea of this use is that the teacher tried to connect the dealing with zero in addition, subtraction and multiplication at all slides. As a result, the students appeared to overcome the difficulties they faced in multiplication concepts and avoided misunderstanding; these slides seemed to help those students to connect and remember what was learned in zero rule in addition and subtraction lessons and about zero rule in multiplication.

During all the presentations, I noticed that the teacher tried to make the most from the positive features provided by this program, for instance, inserting an image and video from file or insert clip art, slide transitions with simple animation effects such as fading slides in and out, background effects, visual effects such as shading and beveling. All these advantages made his presentations more clear and interesting for those students.

4- The effects of technology on students with difficulties in multiplication

These effects are divided into three parts: the first is its effects on teaching, and the second is on learning in general and finally on overcoming the multiplication difficulties.

I noticed the positive impact of this tool on teaching. This included identifying students' strengths and weaknesses. For example, as we know that when students usually hear about technology and all its types, the first thing comes to their mind is fun. Therefore, I noticed that this teacher benefited from this point in terms of making all the students to participate enthusiastically through the use of this tool. This gave the teacher a quick opportunity to know the strengths and weaknesses of all the students in mathematics. As a result, it made it easier for the teacher to build those students mathematically in correct format after knowing the weaknesses of the students. It is important to mention that this effect was considered as a great positive impact on this teacher because two of the mathematics teachers in school B who did not use technology with their students reported to me that it was difficult to recognize the weaknesses of their students easily; as usually the students who had difficulties in mathematics felt embarrassed to raise their hands up in front of their friends to participate in answer any question that was asked by the teacher or if this student had any question to ask the teacher. This embarrassment led to accumulation of all the difficulties and misunderstandings in the students, which resulted to aggravation and continue of the difficulty in the next years of school. All these were because of the type of teaching method that made these difficulties to continue with those students without being discovered and solved.

Moving to the effects of this tool on learning mathematics generally, I noticed that it also appeared to have a positive effect on students in terms of improving and boosting their recall. For example, at the beginning of each lesson, the teacher did a quick review on the previous lesson, to ensure that the students understood the previous lesson well. This led him to build the new lesson on the previous lesson directly. The point that I wanted to make is that I noticed that all the students remembered the previous lesson and recalled the information easily, because when this teacher used IWB and tried to create a picture in the students' mind which made connections between the picture and mathematics tasks which resulted for students to remember the answer of tasks easily. For instance, on the first day of the third week, as usual the teacher asked the students about the previous lesson before he started the new lesson, and I was surprised that only five students raised their hands. The teacher then directly asked how about the rest of the students, whether they knew the answer, and why they did not raise their hands up. However, still the same five students raised their hands. After that I noticed that when the teacher connected this with the picture he had already provided at the previous lesson through IWB, and asked them whether they remembered that picture, amazingly, all the students raised their hands and wanted to answer that question.

Turning to the effect of IWB on learning multiplication particularly, I found that both The Number Race program and PowerPoint presentation also had positive effects on students. This appeared when I noticed that these helped those students in developing their confidence and being less hesitant while answering a question, which increased their capacity for mathematics and problem-solving, which resulted to overcome their difficulties in multiplication concepts.

5- The challenges faced during the use of technology

It is interesting to mention that I did not notice any obstacles that the teacher faced during his lessons while using the IWB. However, to give you indication from my observations, it is enough for me to say that this teacher used IWB daily in innovation and diverse ways such as The Number Race program, PowerPoint and TV. All this is because of his experience and qualifications. In addition, I did not want to forget his head teacher who had significant effect on the continuance of this teacher to use this tool with enthusiasm and determination, as this teacher mentioned during his interviews.

6- Summary

Overall, some of the third teacher's students had difficulty in multiplication included some learners from 20 students who thought that any number multiplied by zero does not equal zero which is the same rule of the addition. Other students directly will borrow from the next number while multiplying 500 by 232. Two students took a long time while answering the task such as $10 - 7$, and sometimes one of them took a long time and answered wrongly such as $20 - 13 = 5$. However, as their teacher used IWB every day, particularly when he used The Number Race program and PowerPoint presentation through IWB, I noticed that these had positive effects on teaching, learning mathematics generally and learning multiplication especially. In teaching, the teacher gave a quick chance to identify the students' strengths and weaknesses, which made easy for him to build those students correctly, and in learning mathematics generally, to improve and boost their recall. In learning multiplication, this tool was able to enhance the students' confidence and did not hesitate while answering the teacher's questions. Finally, it is important to mention that I did not notice any obstacles when the teacher used IWB.

Transcription of Classroom Observations
Teacher four
English Translation

School	**B without technology.**
Date	**10/11/2014 – 25/12/2014**
Number of the lessons	**30 lessons.**
Each class period	**45 minutes.**
Class level	**Year four**
Number of students	**30**
Mathematics lesson	**Subtraction**

1- The description of the classroom and my observations

When I entered this classroom, I found one porcelain steel whiteboard hanging on the wall that all students could see easily. The teacher used this board for writing the mathematics tasks, as this was only the way he could explain the lesson to the learners. After the teacher finished using the board, he would usually sit on his chair and place his hands on the desk. The chair and desk were situated in the corner, from where he could see the entire classroom.

Moving on, I observed that this teacher had organised the seating of the students so that each learner had an independent chair and table, arranged in a traditional row form. On the right side of the classroom, there were two rows, each comprising of five students; in the middle of the classroom, there were three rows of three students each, and on the left, there were two rows, one having five students and another having six. It is important to note that there was enough space to move between the rows on the right and the middle rows, and between the middle rows and the left rows. I noticed that the students sitting in the middle and back rows were more likely to lose focus and converse with their friends, which hindered their understanding of the lesson; and it became difficult for the teacher to observe them. For example, one day, while the teacher wrote on the board, two students sitting at the back were speaking with each other. When the teacher finished writing, he turned around, faced all the students, and asked them a question. The two students were still speaking with each other; when the teacher noticed them, he asked them to repeat the question he had asked. Both of them said they did not know, because they had not heard the question. The teacher scolded them for speaking with each other. The next day, in the beginning of the lesson, the teacher asked the same two students what the lesson was about yesterday, and they answered that they could not remember. This is despite the fact that this teacher was very strict with the students during the lessons.

2- Mathematics as a difficult subject for the students

During my visits to the classrooms, I noticed that some students faced difficulty in borrowing from zero in subtraction calculations. This issue became evident when some students wanted to subtract 1815 from 2004, which is the mathematics problem the teacher asked one of the students to answer. The student directly started with the thousands part and moved on to the right. For example, two minus one equals one, and move on zero minus eight equals eight. I noticed this when he answered zero minus eight as eight. The teacher asked this student to sit and he asked another learner to answer this task, who also continued to solve this task on the right. We continued with this case for up to six students. The seventh student said to the teacher, “No, this not correct, we must to start from the right and move to the left, such as four minus five”. However, when he began to solve four minus five and answered it as one, and moved on the left, which is zero minus one answered one. The teacher asked this student to stop, and he asked another student (i.e. the eighth student) to come to the board to continue solve this task. This student told the teacher that we could not subtract a small number from big number, which I noticed, made the teacher feel happy. However, when the student continued to speak and said that he had to take the zero (placed in the next number four), and put it beside the number four, which became 40.

I noticed that the students were negatively affected while completing expanded subtraction tasks. For instance, when the teacher asked some students to round 7542 to the nearest ten, they tried to avoid putting it as 7540, because they did not want to use the number zero; thus they answered the problem as 7549 or 7543. In addition, when the teacher also asked the students to round 36345 to the nearest thousand and then subtract it from 42543, some of them answered 36456 to avoid using the number zero.

It is interesting to mention also here observations about student behavior in general. I observed two types of behaviour. The first represents the negative side. I saw, in the first ten minutes of the most mathematics lessons, four students each two of who said these phrases: "Stand up, this is my place" and “I will hit you tomorrow, if you take it." In addition, in some lessons when I entered the class, I noticed also that the teacher talked with those four students and said “why you were fighting with your friend this morning" and "Please, do not do it again." The second represents the positive side, in which I noticed some students trying to mediate between those four students. Both cases reflected what I saw during 45 lessons. Meanwhile, the rest of students were very quiet and I did not notice any undesirable behaviour. Actually, the main reason for those four students fighting with each other was because the teacher asked all students not to occupy the same seat every day, and that a student who came first to class would have the priority of the place. However, two students of those four did not want to change their place as they feel uncomfortable if other learners take their places first. Also, the reason why I was able to note this behavior in students was that because most of the mathematics lessons in this classroom were the first lesson, from 7:15 am to 8:00 am, which made it easier for me to see what happened between those students.

3- Teaching methods and its impact on teaching and learning mathematics

With regard to the methods employed by this teacher to explain or teach, I noticed that the teacher used one method to explain the lesson during six weeks of my observations. At the beginning of the class, for 15 minutes, he turned his face towards the board and opened the mathematics book to copy the task from the book onto the board. When the teacher finished writing, he started to explain the lesson. The teacher did not complete his lessons at the end of class time, because I noticed that this method did not facilitate completion of the lesson within class hours.

Moreover, it was difficult for those students to know the goal of each lesson, because the teacher started to read the task on the board and solve it after 15 minutes. This is without knowing the goal of the lesson, or even connecting the previous lesson with the current one. I noticed the negative impacts that emerged from this method; these effects appeared in three aspects.

The first is its effect on teaching mathematics; this included waste of class time without completing the main objective of the lesson, which led to dispersion of the ideas of the students. The second was in learning mathematics; this method does not provide incentives and enthusiasm to ease the difficulty of the subject. The third was in removing the difficulty that students faced in subtraction; this method was unable to build those students in correct way, which resulted in an exacerbation of the difficulty.

4- Summary

Overall, it was clear that those students faced difficulty in understanding the subtraction concepts revolved around borrowing from zero. The teaching method followed by this teacher did not help the students overcome this difficulty. I noticed in this mathematics class that there was a lot of time being wasted without achieving the objective of the class. In learning mathematics, this method does not provide incentives and enthusiasm to ease the difficulty of the subject. Particularly, to overcome the difficulty they faced in subtraction concepts, which were unable to help those students to remove this difficulty, but helped increase it.

Transcription of Classroom Observations
Teacher five
English Translation

School	**B without technology.**
Date	**10/11/2014 - 25/12/2014**
Number of the lessons	**30 lessons.**
Each class period	**45 minutes.**
Class level	**Year five**
Number of students	**32**
Mathematics lesson	**Multiplication**

1- The description of the classroom and my observations

I noticed that in some lessons the teacher took his students to the school library. This library has four big windows which provided good light, ventilation, and view. So, when it rained, the teacher tried to stop teaching for five minutes, and began to speak with the students about nature, the atmosphere, and what clouds are and how they form. In addition, when the day was sunny, the teacher also tried to talk about how the sun works, and so on. It is clear that this teacher feels comfortable teaching in this library, and he is keen to benefit those students to learn about nature.

I noticed that the teacher carried a paperboard with him to explain the lesson on it. The seat arrangement in the library, which helped those students to be in one group, also caught my attention. In addition, there was one desk and a chair for the teacher, which he used some time to correct the students' homework. For more information on the contents of the library, the way the students moved from the classroom to the library and back, and how this teacher dealt with those students, please refer to page number 127.

2- Mathematics as a difficult subject for the students

With regard to the difficulties those students have with mathematics, I noticed that there were some students who had difficulties in understanding that any number multiplied by zero equals zero. This affected them in other aspects, such as they could not differentiate between dealing with the zero in the addition and the multiplication concepts. This resulted in an inability to solve the task properly, particularly while they were dealing with the distribution of property of multiplication over addition. For example, when the teacher asked them to solve the following task: each student pays three riyals to participate in a school trip, and if 42 students participate in this journey, use the distribution property to find all the money already paid by those students?

I found that students struggled a lot when they solved the previous example, because they dealt with two concepts in this task, i.e. multiplication and addition. They took a long time to answer such tasks, and this appeared when they began to answer the previous example. I found they started with correct steps, 3 x 43=3 x (40+3) and they moved on to the next step, which is (3 x 40) + (3 x 2). In the next step, some students struggled to solve 3 x 40, which they could not continue or tried to solve it with a wrong answer, which is 123. On the other hand, some students could not solve this step and the next step. For example, they found it difficult to understand how to deal with the zero in multiplication and addition. Therefore, when they reached this step (3 x 40) + (3 x 2), they found difficult to deal with 3x 40, and the next step, which is 120+6.

While it is true that the teacher went to the library for some lessons with those students and took them out of the classroom, I noticed the students enjoyed being out of the classroom. They raced to go to the place that the teacher asked them to go to. In addition, the way that the teacher dealt with those students during all lessons, which was moderate, which when the students were calm, he interacted with them as a friend. In addition, when they made noise, he was strict with them but without punishing them.

However, none of these tactics helped those students overcome the difficulties they have in understanding the multiplication concepts. This is because the traditional teaching method pursued by the teacher.

Students' behaviour in the classroom

Moving on to the behaviour of the students, I noticed during the 45 lessons that two students talk with each other in some lessons, and the teacher asked them to stop talking. They would immediately stop, but after ten minutes they would start speaking again. In addition, one of the students did not concentrate with the teacher during some lessons which he tried to do another subject's homework, such as that of Science and English. Indeed, I did not notice any bad behaviour among the rest of students; they were quiet and listened to what the teacher said to them. I think the main reason why the above students are doing that is that this teacher preferred moving to the library with his students for most lessons, which affected him negatively in managing his students very well.

3- Teaching methods and its impact on teaching and learning mathematics

In the library, I noticed that at the beginning, for five minutes, the teacher waited until the completion of the students' number during their move from their class to the library or playground. The teacher also started to ask the students to come back to their class around five minutes before the end of class time. As a result, the teacher wasted about ten minutes from the original class time. Because of this, the teacher could not help those students to remove the difficulties in 35 minutes. This appeared when he started to write on the small paperboard with only one task as example to begin with, and he started to explain it for the students, which took about five to seven minutes. And then he asked the student to open their mathematics book. Five minutes before the end of the class, he chose some students to read the rest of the tasks and solve them. Most notably, I noticed that some students hid their faces from the teacher, because they not want to participate.

In the last week, I was curious to know why those students tried hiding from the teacher when the teacher asked the students who wanted to answer the task. Therefore, on Monday, I decided to ask the teacher about my observation, and he answered me that, "Believe me, I don't know the reason". I was surprised on Tuesday and at the beginning of the library time, the teacher asked the students about the reasons. One of those students reported,

> *As you know I have difficulty in mathematics and the way of reading the task and answer it, was not able to help me to understand the lesson well. Which result me to not be keen to participate in front of my friends, because I know I will answer wrong causing me embarrassment.*

He added,

> *My father pay for private teachers who come to our home to teach me what I learned already in school. For me, I found it very useful because that teacher teaches me through my ipad which help me to build the mathematics correctly and*

remember the concepts which led me to connect the previous information with current one.

I was not surprised about the student's response, because I noticed the negative impact of that method used by the teacher in teaching and learning mathematics. With regard to its effect on teaching mathematics, I found that most students did not want to participate, since this method is not stimulating them to raise their hand to interact with the teacher. Moving to its effect on learning mathematics generally, this method contributed to distract the students' attention, which led them to difficulties in understanding the next lesson, because as we know, each lesson relies on the previous lesson. Concerning the effect of this method, particularly in overcoming the difficulties in understanding that any number multiplied by zero equals zero, I found that since this method was unable to provide a lesson in a stimulating and entertaining way, it is difficult for this teacher to help those students to overcome this difficulty in multiplication. This is despite the individual differences between those students, as they did not participate in class.

4- Summary

Considering all this, some students have difficulty in understanding that any number multiplied by zero equals zero. This led them to continue the difficulty even during the transition from one topic to another in mathematics, which became the mathematics complexity. I found that the teacher's teaching methods had a negative impact on teaching and learning mathematics. In teaching, which was not able to spread the spirit of interaction between students through participation leading to an inability to understand the lesson easily. Moreover, in learning math, generally I found that lack of students focus during the lessons that resulted in finding it difficult for the students to understand the next lessons. Finally, in learning that any number multiplied by zero equals zero, also I found it difficult for them to overcome the difficulty they face, because often the difficulty in mathematics arose from the teacher to facilitate and motivate students, instead of only asking them to read the tasks and answer them.

Transcription of Classroom Observations
Teacher six
English Translation

School	**B without technology.**
Date	**10/11/2014 - 25/12/2014**
Number of the lessons	**30 lessons.**
Each class period	**45 minutes.**
Class level	**Year six**
Number of students	**35**
Mathematics lesson	**Multiplication**

1- The description of the classroom and my observations

As previously mentioned, the students' number in this classroom was 35. Therefore, it is an important to start my description of this classroom on how was the seats arrangement for those students. Indeed, when I looked into this classroom for the first time, I felt that this teacher was not going to do group work, discussions, or cooperative learning. This became evident when I found that each student was only was able to look at the backs of head their friends. The classroom had seven rows, two on the right side, three in the middle, and two on the left side, with each row having five students. This teacher allowed for any student to choose his seat not taking into account students who are taller or shorter. I found the students who sit in the front seats, particularly in row number one, three, four, five and six were taller than the students who sit behind them. Which lead me now to describe the board that this class have, and students suffering from a clear vision.

This classroom had one porcelain steel whiteboard, which I noticed that some students who sit in the middle and the last seats were suffering from looking at the board to see what written by their teacher. Which I heard these words from some students said to the teacher such as "I cannot see", or some other said to who sit on the front rows "could you please turn you head to right", "turn your head to left" or "lower your head down". As a result, after the first week, when the teacher explained some tasks on this board, the students found it difficult to understand what this teacher wrote in the board, which led them to not follow the teacher during the lesson, and eventually, did not understand the concepts of mathematics very well.

However, this did not give me a bad impression of this teacher, because I found that the teacher tried to help those students to overcome the difficulties they have in mathematics. This appeared when I noticed that this teacher carries with him his small-sized projectors and laptop, which he bought them from own salary. The teacher finishes with their use, he takes it with him at home, or put them in inside one of the drawers in his desk in this classroom.

This point led me to describe the teacher's desk; I found that this teacher had put his desk in the corner, from where he could see all students clearly, and he put on the desk a box that held a few spare pencils the students could use when needed. Finally, moving to the windows and walls of the class, which I found were four small windows in this classroom, and the walls were painted white colour and without any panels.

2- Mathematics as a difficult subject for the students

It is important to mention that some students found it difficult to answer problems, such as "109 x 4", which most of them did not know how to deal with zero. This manifested when they multiply four by zero and answered four, which as the final answer will be wrong. As a result, I noticed that this difficulty affected them negatively in understanding other concepts in mathematics, such as decimals, and the main reason was that this task has zero in it, and the teacher asked them to multiply. For example, when the teacher asked the students to answer "0.35 x1", I noticed that some students stopped to answer the question because they did not know how to multiply one by zero.

Even the main reason for the teacher for giving this task to the students was to compare the answer for above task with "0.38", in terms of which is bigger or smaller than the other. Thus, those students who did not understand the rule of decimals during the multiplication process, because they struggle or fail to understand that that any number multiplied by zero equals zero.

However, as we know from the teachers' answers to my interview questions, this teacher taught in two schools before joining this school. He used IWB at the first school only, and he knew already the positive impact on those students, and the second, and at this school, he could not use technology because there is no technology available in both schools. Therefore, I noticed that this teacher was keen to use his personal laptop and small projector for a week while I was observing. Indeed, I asked this teacher why he did not use these technologies for all lessons with mathematics, because we could see its positive effect on his students. He answered because the head teacher discourages use of such technology with his students.

Students' behaviour in the classroom

Turning to the behaviour of those students in this classroom, indeed I did not notice a big issue with these students, except for two of them who sit in the back row. In some lessons, they talked with each other, and when the teacher asked them to stop talking, they instead tried to throw a small paper on each other as a method of knowing what his friend wanted from him. The reason for this is the large number of students in this class, which resulted in the teacher not noticing these actions from the students.

3- Teaching method and its impact on teaching and learning mathematics

I observed how he used his laptop and the projector, and its effect on the students, compared not using these tools with using them. I noticed that in the first week, the teacher used his laptop and projector to help those students to overcome their difficulty in understanding that any number multiplied by zero equals zero. Indeed, I felt that this teacher has good ideas on how to use these tools effectively; this appeared when I saw his desktop on his laptop screen, on which I found many applications with a direct relationship with mathematics. When I asked him about these applications, he said he used these programs with his previous students at the first school where he taught.

However, I noticed that in one lesson the teacher tried to use one of his ideas when using these tools. This included turning the electronic copy book from his laptop through the projector to the whiteboard. Actually, I found this method had a positive effect on teaching and learning mathematics. This appeared when I saw that this way saved the class time, in terms of allowing him to give the students enough time to understand the lesson, and practice many examples that made them remember the lesson that led them to connect the previous lesson with current one easily.

During my observations from the second week to the end of last week, I noticed that he did not use these tools with his students, which I found had a negative impact on students' progress. This appeared when this teacher went back to the traditional method when he explained the lessons, which was for the first 15–20 minutes, when the teacher was busy typing the tasks on the board. After that, he started to explain the lessons to them, and the last 10 minutes he asked those students to transfer the answer from the board to their book, which I noticed with this method, the teacher wastes the class time writing on the board, which reflected negatively on students' learning. This did not allow them to practice the lesson more, to be easy to remember it and make them feel confident in terms of solving the task when they find it in upcoming lessons.

4- Summary

Overall, I can see from the above observations that some students have experience difficulty in understanding that the answer will be zero when you multiply any given number by zero. This difficulty led them to struggle to understand other areas in mathematics, such as decimals, because when they started to solve the task such as 0, 35 x1 directly they stopped as they did not know the result of one multiply by zero. As a result, they forgot the main goal of this task, which was to learn how to multiply decimals with whole numbers. Eventually, they found the difficulty worsened and did not find it easy to understand mathematics. However, as their teacher taught mathematics with technology before, he knew about its positive effect on his students. Therefore, he used his own laptop and projector for one week, and we saw its positive impact on teaching and learning math. This included saving the class time, which allowed those students to practise more tasks, which led them to remember and self-confidence when they solve this task in next lessons. Compared with the use of the traditional method without technology, which impacted negatively on those students. This was the main reason for this teacher not using these tools all lessons with his students, because the head teacher affected negatively on this teacher, which led him to not continue using these tools.